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FINAL
SITE HEALTH AND SAFETY PLAN
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
H.O.D. LANDFILL
ANTIOCH, ILLINOIS

MARCH 1993

PREPARED FOR:
WASTE MANAGEMENT OF ILLINOIS, INC.
WESTCHESTER, ILLINOIS

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INTRODUCTION

The objective of this plan is to conduct necessary on-site remedial investigation field work at the H.O.D. Landfill in Antioch, Illinois in a manner which minimizes any potential for accident, and which is adequately protective of the public, the environment, and project workers. In order to achieve this objective, all of the operations conducted at this site will be in accordance with the requirements of the Hazardous Waste Operations and Emergency Response Standard, OSHA 29 CFR 1910.120, and with all of the applicable subparts of the OSHA Construction and General Industry Standards, 29 CFR 1926. These subparts include Subpart C - General Safety and Health Provisions, Subpart D - Occupational Health and Environmental Controls, Subpart E - Personal Protective and Life Saving Equipment, Subpart F - Fire Protection and Prevention, Subpart G - Signs, Signals and Barricades, Subpart I - Tools-Hand Power, Subpart K - Electrical, Subpart L - Ladders and Scaffolding, Subpart O - Motor Vehicles, Mechanized Equipment and Marine Operations and Subpart P - Excavations Trenching and Shoring of the OSHA Construction Standards. Additional OSHA Construction and General Industry Standards may apply, depending on the nature of the operations which might evolve on the site during the course of the Remedial Investigation and Feasibility Study (RI/FS).

Requirements for OSHA 29 CFR 1910.1017 Vinyl Chloride and OSHA 29 CFR 1910.1025 Lead Standards may apply during the course of the RI/FS.

SITE SUMMARY

2.1 SITE LOCATION

The Site is located within the eastern boundary of the Village of Antioch in Lake County in northeastern Illinois (Township 46 North, Range 10 East, Sections 8 and 9). The Site is bordered on the south and west by Sequoit Creek. The Silver Lake residential areas and undeveloped land is located to the north. A large wetland area extends south of the Site from Sequoit Creek. Silver Lake is approximately 200 feet southeast of the Site. A large industrial park area (Sequoit Acres Industrial Park), constructed on former landfill and fill areas, is located west of the Site and borders Sequoit Creek. The Site location is shown on Figure 1 (Appendix A, Site Maps).

2.2 SITE DESCRIPTION

The Site consists of a total 80 acres, of which 51 acres have been landfilled. Although the landfill area is visually continuous, it consists of two separate landfill areas, identified as the "old" and the "new" landfills. The "old" landfill consists of 24.2 acres situated on the western third of the property. The "new" landfill consists of 26.8 acres situated immediately east of the "old" landfill. The two landfill areas have been legally delineated and a division line established under a special condition of permits (No. 1975-22-DE and No. 75-329) issued by IEPA, Division of Land Pollution Control.

2.3 HISTORY OF OPERATIONS

Ownership

Waste disposal activities began at H.O.D. Landfill in 1963 and continued through Site closure in 1984. The Site has been owned and operated by three distinct companies:

- Cunningham Cartage, Inc. (1963-1965)
- H.O.D. Disposal Inc. (1965-1972)
- C.C.D. Disposal, Inc. (1972 - present, including merger with WMII)

Murrill Cunningham, owner, operator, and president of Cunningham Cartage, Inc. operated a 20-acre landfill at the Site from 1963 until August 1965. The property was then purchased by John Horak and Charles Dishinger, who operated the Site under the name H.O.D. Disposal, Inc. In December 1972, the 20-acre landfill was conveyed to C.C.D. Disposal, Inc. and C.C.D. Disposal, Inc. purchased the adjacent 60-acres of land to the east of H.O.D. Landfill. WMII merged with H.O.D. Disposal, Inc., and C.C.D. Disposal, Inc. gaining ownership of the entire Site. H.O.D. Disposal, Inc. and C.C.D. Disposal, Inc. became subsidiaries of WMII through the merger. WMII operated the landfill from 1973 until 1984 when the Site was closed. During the time WMII operated the landfill, portions of the 60-acre property were opened for landfiling (Ecology and Environment, 1989). In January 1975, WMII donated two parcels of the 60-acre expansion property to the Village of Antioch, but retained rights to operate a landfill on each parcel for designated periods of time.

2.3.1 Waste Disposal Activities

Murrill Cunningham began operating a sanitary landfill on the 20-acre property in 1963 under a Lake County Health Department (LCHD) permit. Cunningham Cartage applied to LCHD for a permit to expand landfiling operations onto the adjacent land parcel. The permit was denied by LCHD because the adjacent area was not zoned for a sanitary landfill (Ecology and Environment, 1989).

In August 1965, H.O.D. Disposal, Inc. took over operation of the 20-acre landfill. H.O.D. Disposal, Inc. operated under a LCHD permit from August 1965 through March 12, 1975 when the IEPA approved the state permit. In October 1965, H.O.D. Disposal, Inc. applied to LCHD for expansion of the landfill area to 80 acres. The application was rejected because of zoning. In 1971, all solid waste disposal facilities in Illinois were required by State law to obtain operator permits from IEPA. In October 1973, WMII submitted a zoning request to the Village Zoning Board for operation of an 80-acre landfill. WMII submitted a permit application to IEPA on June 26, 1974. The IEPA set a July 27, 1974 deadline for WMII to acquire a permit. The IEPA fined WMII \$5000 in August 1974 for not

having an approved permit. On October 21, 1974 the zoning request was approved and on March 12, 1975 the IEPA approved the development permit.

Development Permit No. 1975-22-DE issued by IEPA on March 12, 1975 allowed disposal of general solid waste, excluding liquid and special wastes, on the 60-acre expansion. The permit specified special conditions, including:

- Leachate collection
- A surveyed separation between the "old" and "new" landfill areas
- Groundwater monitoring
- Allowance for a compensatory flood storage area for Sequoit Creek overflow

Between July 1975 and the closing of the landfill in 1984, various supplemental permits were granted by IEPA to WMII to modify development and operational permits for the Site. The supplemental permits include, but are not limited to:

- Installing a fence around the entire Site and a berm along the east side
- Modification of the leachate collection system
- A change in the method of landfilling
- An increase in depth on a portion of the landfill to install seals along the southern boundary
- Various supplemental permits allowing disposal of special wastes

A woven wire mesh fence with barbed wire was installed around the north, south and west sides of the Site with a locking chain-link gate across the access road. The east side was fenced with screened chain-link fence with barbed wire. Also on the east side, an 8-foot high clay berm with shrubs was constructed to further reduce noise and visual exposure to residences to the east.

During operation of the Site, permits were issued by the IEPA for the disposal of municipal waste and a variety of industrial wastes and special wastes. The industrial wastes and special wastes disclosed on the permits included, but were

not limited to:

- Waste oils and chlorinated solvents
- Emulsions polymerization waste containing phenol, lead, and zinc
- Various industrial sludges and municipal waste water treatment sludges
- Baghouse dust and grinding sludge containing chromium, cyanide, and nickel
- Paint booth waste
- Waste filter cake and latex sludge containing cyanide, phenol, and zinc
- Water soluble coolant and oil waste

Based on a review of WMII records, special permitted wastes account for approximately 2% of the total volume of wastes disposed.

In 1982, WMII applied to the IEPA for a supplemental permit to expand landfilling operations onto adjacent land to the north which had been used as a borrow area for cover materials. The permit application was denied. WMII then applied for a supplemental permit to raise final contours. The request was denied based in part on the argument from the Village of Antioch that the modifications would make it impossible to implement its plans to build a light industrial park over the H.O.D. Landfill. WMII appealed the decision through the Illinois judicial system to the Illinois Supreme Court. The court upheld the IEPA's decision to deny expansion. WMII ceased accepting waste for disposal at the Site in 1984.

2.4 PREVIOUS SITE INVESTIGATIONS

Several investigations have been conducted at the Site. These investigations are briefly discussed in the following paragraphs.

A soil investigation was conducted by Testing Services Corporation (TSC) in 1973 to assess conditions for the expansion of the landfill and the construction of an on-site maintenance building. Twenty-five borings were constructed (TSC, 1973).

TSC installed six groundwater monitoring wells for WMII in May 1974.

A hydrogeologic report for the proposed landfill expansion to the north was prepared in 1982 (McComas, 1982). The report was based in part on 26 soil borings drilled by TSC at the Site in 1981.

IEPA prepared a trend analysis report summarizing chemical analysis of samples collected from monitoring wells at the Site and submitted the report attached to a letter dated May 7, 1982 to the Illinois Attorney General's Office. The report summarized the analytical data collected between November 1974 and December 1981 from the six on-site monitoring wells (IEPA, 1982).

A preliminary assessment (PA) was completed on February 11, 1983 by the FIT at the request of the U.S. EPA. The PA identified several data gaps including determination of waste quantity and information related to possible groundwater or surface water contamination.

A site investigation (SI) was conducted on July 10, 1984 by the FIT. Groundwater samples were collected from on-Site monitoring wells. Analysis of groundwater samples, particularly from one well, reportedly revealed the presence of elevated concentrations of zinc, lead, and cadmium. Analysis of surface water samples did not reveal elevated levels of analyzed parameters.

Dames and Moore conducted a hydrogeologic assessment of the Site at the request of WMII. The assessment was described in a report dated November 12, 1985. The report provided a brief summary of past groundwater sampling activities and an evaluation of chloride, zinc, and total dissolved solids in samples collected from the Village of Antioch Well 4, a monitoring well, and a leachate sample (Dames and Moore, 1985).

On January 9, 1986, IEPA collected groundwater samples from four residential wells located east of the Site. The samples were analyzed for nitrates, organic compounds and trace metals. The results of the chemical analysis indicated no maximum allowable concentrations for trace metals and no organic compounds were detected.

An ESI was conducted by the FIT (Ecology and Environment, 1989) during the period 1987 through 1989. The ESI consisted of the following activities:

- Review of existing records
- EM survey
- Drilling 15 soil borings
- Installing 13 monitoring wells
- Measuring groundwater and surface water levels
- Hydraulic conductivity testing

- Pump testing
- Soil and groundwater sampling and analysis

The Village of Antioch filed an eleven (11) count complaint in September of 1984 against defendants Waste Management, Inc., Waste Management of Illinois, Chemical Waste Management, Phillip Rooney, Peter Huizenga, Trygve Bakkom and James DeBoer. The original complaint was dismissed in its entirety upon the motion of the defendants.

In May of 1985, the plaintiff Village of Antioch filed its Amended Complaint. Thereafter, the defendants filed additional motions to dismiss this Complaint. The motion to dismiss was granted in part and denied in part. Defendants have denied the substantive allegations in each of the counts. Each of the counts of the law suit as stated within the Amended Complaint centers upon the rezoning of the subject property in 1973 through 1974 and upon the operations of the landfill from 1975 through its closure in 1984. The plaintiff claims that the ordinance rezoning the property is also a contract. Defendants strongly deny this allegation. Plaintiff further alleges that the defendants misrepresented how the landfill would be developed and operated. Defendants also strongly deny these allegations. Finally, plaintiff alleges that the landfill constitutes a nuisance.

During the period 1989 through July 1990, P.E. LaMoreaux & Associates, Inc. (PELA), on behalf of WMII, conducted various Site investigations related to the litigation between the Village of Antioch and WMII. These investigations included the following activities:

- Drilling borings
- Temporary piezometer and staff gauge installation
- Water level measurements
- Grain size and permeability testing of soil samples
- Domestic well inventory
- Geophysical logging
- Selected survey at Village of Antioch Well 4
- X-ray diffraction analysis of soil samples

The objective of PELA's investigation was to fully characterize Site geology and hydrogeology. The results of investigation activities listed above were used to determine:

- The lateral and vertical extent of the surficial sand.
- The lateral and vertical extent of the clay diamict which separates the surficial sand from the deep sand and gravel aquifer.

- The direction of groundwater flow in the surficial sand and the deep sand and gravel aquifer.
- The potential for hydraulic connection between the surficial sand and deep sand and gravel aquifer.
- The relationship between the shallow groundwater flow system and Sequoit Creek.
- The depositional history of glacial deposits in the Site vicinity.

Patrick prepared an Environmental Audit of Sequoit Acres Industrial Park in 1989 on behalf of WMII legal counsel. The purpose of the investigation was to identify potential contaminant sources within the industrial park and evaluate potential routes of contaminant migration. The investigation evaluated aerial photographs, published data on geology/hydrogeology, and history of land uses. Soil borings were performed to define site stratigraphy.

Patrick concluded that several potential sources of soil and/or groundwater contamination existed in the Sequoit Acres Industrial Park, including industry and landfilled areas containing both fill and refuse. The Patrick report further indicated "The isopach of refuse, Figure 13 [in the Patrick report], indicates that it is probable that the fill on the water well drillers log for well No. 4 was actually refuse."

Shallow borings were drilled at three locations on October 23, 1989 by Patrick for Geoservices Inc. of Boynton Beach, Florida to collect samples of the clay diamict. Geoservices conducted laboratory permeability tests on five clay samples collected from these borings.

Five temporary leachate piezometers (TLP1 through TLP5) were installed at the "old" landfill for WMII by Stratigraphics, Inc. on July 24 and 25, 1990. Prior to piezometer installation, a piezometric cone penetration test was performed at each location to determine subsurface conditions. The stratigraphics report indicated clay underlies refuse at each of the temporary leachate piezometer locations. Leachate samples were collected for laboratory analysis from temporary leachate piezometers. Samples were analyzed for organics, metals and indicator parameters.

Groundwater quality samples were collected by WMII at ten on-Site monitoring wells on July 25 and 26, 1990. Samples were analyzed for organics, metals and groundwater quality indicator parameters.

The U.S. Geological Survey (USGS), in cooperation with the U.S. EPA, performed an evaluation of the aquifer pump test data collected during the ESI Report and presented the results in a report titled "Determination of Hydraulic Properties In The Vicinity Of A Landfill Near Antioch, Illinois" (USGS, 1990).

WMH and Warzyn have evaluated the report and have prepared the following response which addresses several questions and concerns related to data interpretation. In summary, the results of the aquifer test indicates that the clay diamict is continuous throughout the area of the test as evidenced by the lack of water level response in wells screened in the surficial sand and gravel.

The report recognized that the aquifer test analysis methods chosen were not derived specifically for the hydrogeologic characteristics of the Site. Designing and analyzing an aquifer test at the Site is a difficult proposition because of the complex hydrogeology and the existence of operating municipal water supply wells. As a result several of the assumptions inherent in the chosen test analysis methods can not be met. Several specific concerns have been identified during our review of the report and are discussed below.

- The report states that "the data and analysis do not clearly show that water from the upper aquifer moved into the confining bed during the test." Yet the report concludes that if leakage from the surficial sand to the deep sand and gravel has occurred, contaminants present in the surficial sand could move into the deep sand and gravel aquifer. We believe additional study is required prior to hypothesizing on the potential for contaminant migration into the deep sand and gravel aquifer. The RI will define the extent of groundwater contamination resulting from the Site, if any.
- The deviation in drawdown from the type curve could be related to one or more of the following factors: presence of a recharge boundary (water body); leakage from confining layer; effects of partial penetration; nonuniform aquifer thickness; and presence of heterogeneous aquifer. The report assumed the deviation was due to leakage from the overlying confining unit and did not evaluate the other possibilities.
- Village Well 4 is not a fully penetrating well and is not sealed through the entire thickness of the clay diamict. As a result, drawdown data may be distorted to resemble a recharge boundary. In addition, the granular backfill surrounding the well screen and well casing extends up to within approximately 17 feet of the top of the clay diamict and the well seal is reported to be redi-mix concrete. The potential exists that the

seal is inadequate and a preferential downward pathway for groundwater movement exists. Village Well 4 will be decommissioned by Waste Management of North America under an agreement with the Village of Antioch.

- The aquifer is assumed to be of uniform thickness. The deep sand and gravel, in fact, varies in thickness by as much as 110 feet in the Site vicinity. The effect of a nonuniform aquifer thickness is that drawdown data may resemble those of a recharge or discharge boundary.
- The aquifer is heterogeneous, but the analysis method assumes it is homogeneous. If zones of relatively high conductivity exist in the test area the drawdown data may resemble those of a leaky aquifer.
- The clay diamicton thickness is not uniform. The thickness near the Site ranges from 10 feet to 129.5 feet. In the Hantush and Jacob (1955) method, the hydraulic conductivity of the confining unit is equal to the rate of leakage through the confining unit times the thickness of the confining unit. The USGS assumed the clay thickness was a uniform 25 feet.
- The clay underlying the deep sand and gravel is not impermeable (as assumed by the analysis methods) and leakage from below could cause the drawdown curve to depart from the type curve. As a result, the hydraulic conductivity of the clay diamicton would be overestimated (the actual conductivity of the clay diamicton would be less than estimated).
- Several exploratory borings were drilled through the clay diamicton in Sequoit Acres Industrial Park by the Village of Antioch prior to drilling well 4. These borings were reportedly sealed with clay slurry. However the nature of the clay slurry is unknown and these borings may provide a preferential pathway for water to move from the surficial sand to the deep sand and gravel.
- The water level change at well US6I (screened in the clay diamicton) was approximately 0.08 feet. This change may be related to barometric pressure change, pre-pump test water level trends and/or pumping of well 4. The USGS report assumed the change was related to pumping of well 4. The USGS report did present changes in barometric pressure along with changes in water levels (Figures 8 and 9 of USGS Report) and recognized the potential effects of partial penetration and surface water recharge when interpreting pump test data.

The most important conclusion which can be drawn from the USGS pump test report is that the clay diamict is continuous across the site and that it is characterized by low hydraulic conductivity. The report is inconclusive regarding the potential for contaminant migration from the surficial sand to the deep sand and gravel aquifer. Aquifer characteristics presented in the report are estimates because several assumptions used in the analysis were not met.

Additional investigation of Site hydrogeologic characteristic and potential contaminant migration pathways will be performed during the RI to evaluate the potential for hydraulic communication between the surficial sand and the deep sand and gravel. Water levels will be monitored to assess the vertical flow component in the surficial sand and to compare heads in the surficial sand and deep sand and gravel.

2.5 ENVIRONMENTAL SETTING

2.5.1 Climate

The Site is located within a continental climatic belt characterized by frequent variations in temperature, humidity and wind direction. The average daily minimum temperature is 15°F in January and the average daily maximum is 83°F in July. The average annual precipitation is 32.5 inches. The wettest months are April through September (USDA, 1970).

2.5.2 Physiography

The Site is situated in the vicinity of the Wheaton moraine within the Great Lakes section of the Central Lowland Province. The topography in the area is generally characterized by gentle slopes with poorly defined surface drainage patterns, depressions, and wetlands. The maximum relief in Lake County is 340 feet.

The topography in the vicinity of the Site is generally flat. The most prominent topographic feature in the area is the landfill. The maximum elevation of the landfill is approximately 800 feet mean sea level (MSL). The elevation of Sequoit Creek is approximately 762 feet MSL. Maximum ground surface relief at the Site is approximately 40 feet.

2.5.3 Hydrology

Surface drainage around the Site is generally toward the Fox River, located approximately 5 miles to the west. Locally, surface water flows from the Site toward Sequoit Creek.

Sequoit Creek originally flowed northwest from Silver Lake to a point that is now the approximate center and northern boundary of the Site, where it then flowed

west toward the Village of Antioch. However, Sequoit Creek was rerouted to flow west from Silver Lake along what is currently the southern boundary of the Site sometime between 1964 and 1967. At the southwestern corner of the landfill, the creek was routed to flow north along the western boundary of the Site. Approximately 250 feet north of the northwestern corner of the Site, the creek flows toward the west approximately 2 miles before discharging into Lake Marie. Lake Marie eventually discharges to the Fox River. Based on aerial photographs and a 1960 USGS topographic map of the Site area, the eastern portion of the Site was shown as a wetland prior to landfill development.

2.5.4 Surface Soils

The following surface soil types were found at the Site prior to Site development and may still be present in undeveloped areas.

- Houghton muck, wet
- Morley silt loam
- Zurich silt loam
- Peotone silty clay loam
- Peotone silty clay loam, wet
- Mundelein silt loam
- Miami silt loam

The Houghton muck, Peotone silty clay loam are classified by the USDA Soil Conservation Service (SCS) as hydric soils. The Zurich silt loam and Mundelein silt loam are non-hydric soils that may contain hydric inclusions. A brief description of each soil type follows.

The **Houghton** series consists of deep, level to depressional, very poorly drained organic soil that formed in fibrous plant remains deposited in swampy areas. The Houghton muck generally receives run off from surrounding uplands and is subject to ponding. The water table is at or near the surface most of the year.

The **Morley** series consists of deep, gently sloping to steep, well drained to moderately well drained soils that formed in thin silty deposits in the underlying calcareous glacial till. The Morley silt loam is generally found on tops of morainic ridges.

The **Zurich** series consists of deep, level to moderately steep, well drained to moderately well drained soils that formed in 2 to 3 feet of silty material and the underlying calcareous stratified silt and sand. The Zurich loam is found on outwash plains.

The **Peotone** series consists of deep, level to depressional, very poorly drained soils that formed in thick silt and clay, water deposited materials. These soils are in low areas throughout the county. The Peotone silty clay loam, wet, is subject to ponding from water that runs off surrounding uplands. The water table is at or near the surface most of the year. The Peotone silty clay loam is also subject to ponding, but is drained artificially.

The **Mundelein** series consists of deep, level to gently sloping, somewhat poorly drained soils that formed in 2 to 3 feet of silty material over calcareous stratified silt and sand. The Mundelein silt loam occurs on outwash plains mainly in the valley of the Des Plaines River.

The **Miami** series consists of deep, gently sloping to strongly sloping, well drained to moderately well drained soils that formed in thin silty deposits and the underlying calcareous glacial till. The Miami silt loam is generally found in morainal areas.

2.5.5 Geology

Regional Bedrock Geology. Lake County is located along the northeastern flank of a northwest/southeast trending structural high known as the Kankakee Arch. The bedrock surface of northeastern Illinois varies in depth from 90 to 325 feet below the ground surface (Woller and Gibb, 1976). The bedrock surface dips gradually toward the east and exhibits an uneven surface as the result of pre-glacial erosion.

Throughout most of Lake County, the uppermost bedrock unit is the Silurian dolomite of the Niagaran Series. This dolomite unconformably overlies Upper Ordovician, Maquoketa Group shales, and ranges in thickness from 0 to 270 feet. The Maquoketa Group is the uppermost bedrock unit in small isolated areas along the western portion of the county. The Maquoketa Group ranges in thickness from 100 to 240 feet and consists primarily of thick non-water-bearing shales. The Maquoketa Group is underlain by a sequence of Cambrian and Ordovician sandstones and dolomites which, in turn, overlie Precambrian granite rock.

Regional Glacial Geology. The bedrock surface in Lake County is completely overlain by thick sequences of glacial deposits. These unconsolidated deposits exhibit evidence of multiple episodes of glacial advances and retreats of late Wisconsinan glaciation. The surface topography of the area is characterized by a series of parallel, onlapping moraines and intermorainal valleys. This morainal complex is composed of deposits of the Wadsworth Till Member of the Wedron Formation. Deposition of the Wadsworth Till represents the last retreat of the Joliet Sublobe of the Lake Michigan Lobe (Willman and Frye, 1970). The

moraines decrease in age toward the east and are overlapped by lacustrine deposits of the Lake Chicago plain.

Approximately 90 to 325 feet of Woodforian age glacial deposits overlie bedrock in northeastern Illinois. The Wadsworth Till Member of the Wedron Formation is the primary unconsolidated deposit in Lake County and ranges in thickness from 5 to 150 feet. The Wadsworth Till Member is underlain sequentially by the Haeger Till Member and Tiskilwa Till Member. The Tiskilwa Till Member overlies the Racine Dolomite. The glacial deposits are discussed in order of deposition in the following paragraphs.

A reddish-gray, silty clay till (Tiskilwa Till Members) overlies the Racine Dolomite in the region. This till unit is generally regarded as the lowermost member of the Wedron Formation that is present in the area (Willman, 1971). The unit is interpreted to be basal till probably deposited by lodgement (Johnson, et al, 1985). The Tiskilwa Till Member consists of a lower unit consisting of a sandy silt with clay and a massive main unit which consists of approximately equal percentages of sand, silt and clay. No Site borings have penetrated this unit.

In the vicinity of Antioch, the Tiskilwa Till Member is overlain by the Haeger Till Member of the Wedron Formation. The Haeger Till Member was deposited by the Harvard Sublobe of the the Lake Michigan Lobe, is laterally extensive and consists of sand and gravel outwash deposits with some clay rich diamicts present. Outwash and till deposits of the Haeger Till Member outcrop locally along the western edge of Lake County and westward into McHenry County.

The Wadsworth Till Member overlies the Haeger Till Member. The Wadsworth ice of the Joliet Sublobe advanced westward across Lake County entraining recently deposited lake sediment and Paleozoic shales and limestone, resulting in a clay-rich debris load. The ice advance terminated near the Chain of Lakes lowlands. As the ice retreated the clay-rich load was deposited as the Wadsworth Till. The Wadsworth Till is characterized by gray, fine-grained clay rich diamict, and interbedded, sorted silts, sands and gravels. Diamict is defined as poorly to nonsorted sediment containing a wide range of particle sizes, regardless of sediment genesis. The diamict is laterally extensive and is present near the surface in most of Lake County.

Site Specific Geology. The Site area is underlain by differentiated deposits of sand, gravel, and silty clay. The unconsolidated deposits encountered by borings drilled at the Site consist of a depositional sequence of till and outwash deposits associated with the surficial Cahokia alluvium (Holocene) and underlying Wadsworth and Haeger Till Members of the Wedron Formation. The unconsolidated deposits are divided into four distinct depositional units, in order

of increasing depth and age:

- Surface soils
- An elongated surficial sand (that includes deposition within the Wadsworth Till Member and post glacial sand) of limited vertical and lateral extent which is present near the southern boundary of the landfill
- A clay diamict (Wadsworth Till Member)
- A deep sand and gravel aquifer (Haeger Till Member)

Surface Soils. Surface soils include clayey to gravelly topsoil, peat, and fill material (disturbed soil). The surface soils range in thickness from approximately 2 to 9 feet.

Isolated lenses of silty sand and organic-rich clay observed overlying the surficial sand unit are representative of fine-grained, post-fluvial environments such as wetland or overbank deposits. A thin lense of sand and gravel exists near the surface north of the landfill. The lense does not appear to be really extensive and does not extend into the landfill area.

Surficial Sand. The surficial sand is limited in both vertical and horizontal extent, exhibits an elongated geometry and trends east-northeast/west-southwest along the southern boundary of the Site.

The top of the surficial sand begins at depths ranging from 7.5 to 20 feet below ground surface. The unit ranges in thickness from 0 to approximately 54 feet. The surficial sand generally consists of light brownish gray to dark gray, fine to medium grained sand and gravel. It is poorly to well sorted and contains angular to rounded gravel of mixed lithology.

Clay Diamict. The clay diamict is laterally extensive and is present beneath most of Lake County. The clay diamict represents deposits of the Wadsworth Till Member. The clay diamict is present beneath the entire Site based on borings drilled during previous investigations.

The top of the clay diamict is present immediately beneath the surface soils along the northern boundary of the site and may be as deep as 60 feet below ground surface where it underlies the surficial sand south of the Site. The thickness of the clay diamict ranges from greater than 100 feet (north of the site) to 10 feet south of the "old" landfill. The clay diamict is typically massive, light gray to dark gray

in color and contains thin, isolated, discontinuous silt seams and sand seams. Lenses of clay and gravelly clay exist within the diamict.

Deep Sand and Gravel. The deep sand and gravel is laterally extensive and is present beneath the entire Site. The full thickness of deep sand and gravel is not known, but the unit is at least 185 feet thick in the Site vicinity (Ecology and Environment, Inc. 1989). The upper portion of this unit consists primarily of medium to coarse-grained sand with some fine-grained sand and gravel. The unit is moderately well sorted and generally coarsens with depth. Lower portions of this unit are poorly sorted and contain greater percentages of gravel. The deep sand and gravel represents outwash deposits associated with the Haeger Till Member (Willman, et al, 1975).

2.5.6 Hydrogeology

Regional Hydrogeology. There are three major aquifers in northeastern Illinois:

- The deep Cambrian-Ordovician aquifer
- The shallower dolomite aquifer of Silurian age
- Deposits of glacial origin (such as the deep sand and gravel aquifer at Antioch)

Producing units in the deep Cambrian-Ordovician aquifer include the Galena-Platteville Dolomite, Glenwood-St. Peter Sandstone, Ironton-Galesville Sandstone, and Mount Simon Sandstone. The Mount Simon is sometimes considered a separate aquifer because it is separated from the overlying Ironton-Galesville Sandstone by the Eau Claire Shale aquiclude. The shallower dolomite aquifer is separated from the deeper aquifers by the Maquoketa Shale. In some locations, the deeper sand and gravel directly overlie the shallower dolomite aquifer and the two units are hydraulically connected.

Of the bedrock aquifers, the Silurian dolomite is the primary source of groundwater in Lake County. However, the sand and gravel aquifers provide only slightly less groundwater than the bedrock aquifers (Illinois State Water Survey, 1976).

Sand and gravel deposits, which occur as confined, semiconfined and unconfined aquifers are fairly extensive throughout Lake County. However, the deep sand and gravel aquifer is confined in the area of the Site. The majority of the confined units are located in the western portion of the county. Many residential wells in the Antioch area, and the Village of Antioch's public water supply system, obtain groundwater from glacially derived sand and gravel deposits. The sand and gravel aquifer (Haeger Till Member) used by the Village of Antioch, is recharged in the Fox River Valley, located approximately 4 to 5 miles west of the Site. The

unit is present near ground surface in this area and water from precipitation, lakes, and the Fox River can enter the sand. Groundwater within this unit flows from this recharge area to the east toward Lake Michigan.

The shallow bedrock aquifer (the Silurian dolomite) is tapped by many public water utility systems in the county. The yield capacity of this aquifer varies depending upon interconnection of fractures and aquifer thickness (Woller and Gibb, 1976). The aquifer is recharged by the downward migration of water from the overlying glacial deposits where sand and gravel deposits are in contact with the bedrock surface.

The depth of wells in the deep aquifer averages about 1,300 feet, and many of the wells yield over 700 gpm. Wells in the shallow dolomite are set to an average depth of about 300 feet. Depths of wells in the sand and gravel are generally less than 140 feet. The highest yielding sand and gravel wells (greater than 500 gpm) are generally located in major valley systems.

Site Specific Hydrogeology. As discussed in the previous section, three major aquifers underlie the Site. The following discussion focuses on the deposits of glacial or Recent origin. Water-bearing glacial or Recent deposits consist of the surficial sand, underlying clay diamict aquiclude and deep sand and gravel aquifer.

Surficial Sand. The surficial sand is present along the southern Site boundary and exhibits an elongated east-northeast/west-southwest trending geometry.

Water table conditions exist in the surficial sand. Groundwater flow in the sand is generally from the perimeter of the surficial sand deposit toward Sequoit Creek. Groundwater flow direction is influenced by Sequoit Creek which traverses the southern and western boundary of the Site. PELA installed shallow piezometers along the creek to evaluate surface water/groundwater interaction. Their evaluation indicated that shallow groundwater discharges to Sequoit Creek.

The estimated horizontal hydraulic conductivity for the surficial sand ranges from 4.8×10^{-4} cm/sec to 7.0×10^{-3} cm/sec based on slug tests conducted by E & E.

Clay Diamict. The surficial sand is separated from the deep sand and gravel aquifer by the clay diamict based on borings conducted in the vicinity of the Site. The thickness of the clay diamict varies beneath the site. Based on an isopach map of clay, the thickest portion of the clay is in the northeast part of the landfill. The lithologic description of the clay indicates that the clay is massive, plastic, and characterized by low hydraulic conductivity.

The clay diamicte impedes movement of groundwater from the surficial sand to the deep sand and gravel aquifer, based on piezometric head levels observed in wells screened in each unit. Groundwater level data collected by PELA on April 23, 1990 indicate heads in the surficial sand ranged from approximately 761.6 to 764.5 feet MSL while heads in the deep sand and gravel aquifer ranged from 727.3 to 730.8 feet MSL. This head differential of approximately 30 feet substantiates the poor hydraulic communication between the surficial sand and the deep sand and gravel aquifer which results from low hydraulic conductivity of the clay diamicte.

Horizontal hydraulic conductivities in the clay diamicte were estimated to be 7.9×10^{-6} cm/sec and 8.0×10^{-6} cm/sec at wells US3I and US6I, respectively based on slug tests conducted by E & E. The vertical hydraulic conductivity of the clay diamicte ranged from 1.0×10^{-8} cm/sec to 6.9×10^{-7} cm/sec, based on constant head permeability tests performed on samples collected from borings. Constant head permeability tests conducted on clay diamicte samples obtained from the Site by Geoservices Inc. resulted in vertical hydraulic conductivity values ranging from 9.0×10^{-9} cm/sec to 8.4×10^{-8} cm/sec using Site groundwater as the fluid and 8.5×10^{-9} cm/sec to 6.0×10^{-8} cm/sec using Site leachate as the fluid (Williams, 1990).

Deep Sand and Gravel Aquifer. The deep sand and gravel aquifer occurs beneath the entire Site based on Site borings. This unit has not been entirely penetrated at the Site and therefore its thickness is not known.

The deep sand and gravel aquifer is under confined or semiconfined conditions. As indicated previously, groundwater elevations in the deep sand and gravel aquifer range from approximately 727 to 731 feet MSL.

Primary groundwater recharge to the deep sand and gravel aquifer occurs in the Fox River Valley where the aquifer crops out. As groundwater flows toward the east from the recharge area, the aquifer is confined by the clay diamicte.

A groundwater divide is located beneath the eastern portion of the Site. Data indicates that the groundwater divide is caused by pumping of Village water supply wells. Groundwater east of the divide follows the regional groundwater flow direction while groundwater west of the divide is diverted toward the Village wells.

Water level data collected by the U.S. EPA FIT during September and October 1987 for the ESI suggested groundwater flow direction in the deep sand and gravel aquifer was influenced by pumping of Village wells 4 and 5. The groundwater flow direction on September 10, 1987 was toward Village well 4 and on October 28, 1987 was toward Village Well 5. Data collected during the

December 1987 pump test indicated well US1D was affected by pumping of Village Well 4. Under these pumping conditions no groundwater divide existed beneath the Site.

The horizontal hydraulic conductivity of the deep aquifer is estimated to range from 1.1×10^{-3} cm/sec to 1.6×10^{-6} cm/sec based on slug test data collected by the FIT. The surficial sands is present only along the southern portion of the Site and is not used for water supply. The deep sand and gravel aquifer is used for water supply by the Village of Antioch and nearby residences.

2.6 DISCUSSION OF POSSIBLE CONTAMINANTS

Information on leachate characteristics (see H.O.D. Landfill Work Plan (PSER/TS), Appendix F) indicates the following constituents may be encountered at the landfill during intrusive and sampling activities: metals, chlorinated hydrocarbons, and vinyl chloride. A wider range of contaminants may be identified on-site once additional sampling results are obtained and interpreted.

HAZARD EVALUATION

3.1 SITE CHEMICAL HAZARDS

The principal hazards expected at the Site are based upon both typical conditions encountered at landfills and upon analytical data presented in Appendix F of the H.O.D. Landfill PSER/TS. Possible hazards include exposure to explosive levels of methane gas, oxygen-deficient atmospheres, hydrogen sulfide, and exposure to contaminated groundwater.

3.1.1 Combustible Gas (explosive environment)

The methane gas produced by the microbial activity in the landfill and other combustible gases which may be present in the landfill may act as hazardous compounds in two specific ways. First, methane is a flammable gas and may combust when ambient concentrations are between 5% and 15% by volume in air, the lower explosive limit (LEL) and upper explosive limit (UEL) of methane, respectively. Explosions can occur when combustible gases are ignited in confined areas. It will be necessary to have continuous monitoring for combustible gas in the appropriate work areas and to provide engineering controls in areas that have greater than 20% LEL (1% methane). Second, methane is considered a simple asphyxiant: it displaces the oxygen normally breathed in the air. Methane has no odor and it is not irritating to eyes, nose, or throat. However, in association with landfill gas, it is easily detected by its odor.

If inhaled in large quantities, dizziness, difficulty in breathing, and/or loss of consciousness may occur. If these effects are noted, the victim should be removed to fresh air and allowed to breathe freely until dizziness has passed. If the victim is unconscious and not breathing, artificial respiration should be initiated.

3.1.2 Oxygen Deficiency

The microbial activity in the Site which produces methane gas uses available oxygen, thus producing an oxygen-deficient atmosphere. Oxygen deficient atmospheres can initiate drowsiness, loss of mental capabilities and death within minutes. Appropriate work effort at this Site will be monitored on a continuous basis for oxygen-deficient atmospheres. Any areas containing 19.5% oxygen or less are unsafe and project personnel should avoid such areas until the oxygen level is confirmed safe by the Site Safety Officer.

3.1.3 Hydrogen Sulfide

Hydrogen sulfide (HS) has a strong rotten egg odor. The OSHA PEL is 10 ppm and it has a time-weighted average (TWA) of 10 ppm (ACGIH). HS affects the respiratory system, lungs and eyes, and causes dizziness, headache, and fatigue. It also produces olfactory fatigue, such that high concentrations or a continuous exposure to a low concentration are not detected by the human sense of smell.

3.1.4 Contaminated Groundwater and Leachate

Based on available information presented in the PSER/TS (Appendix F), the following substances may be present in the leachate at concentrations which could represent hazards to unprotected project workers:

- 1,2 dichloroethene
- Trichloroethene
- Vinyl chloride
- Metals - zinc, lead and cadmium

Volatile Organic Compounds (VOCs). VOCs present in leachate and in landfill material may require respiratory protection. Standard hazardous waste site protocol requires adequate respiratory protection to be worn in areas where worker's breathing zone concentrations of VOCs are elevated above background level.

Chlorinated Hydrocarbons. These compounds are highly mobile, migrating easily through water, air and soil. They are persistent in the underground environment, although they may degrade at the surface under the influence of ultra-violet light.

Chlorinated hydrocarbons may act on the central nervous system, either as a stimulant or depressant. Mild exposure may cause such symptoms as dizziness, nausea, abdominal pain, and vomiting. In chronic (long-term) exposure presents those symptoms given above followed by severe irritability, convulsive seizures, and coma.

Compounds from this class of chemicals found at the site, as indicated in the leachate analytical data (Appendix F of the PSER/TS), are:

SYM-Dichloroethene - It exists as CIS- and TRANS-. It is a colorless, low boiling point liquid. It is primarily used as solvent; it is moderately toxic by ingestion, inhalation and skin contact; it is an irritant and a narcotic in high concentrations. Some of the symptoms of inhalation exposure to SYM-Dichloroethene include nausea, vomiting, weakness, tremor, central nervous system depression. Contact with liquid causes irritation of eyes and (on prolonged contact) skin. Ingestion causes slight depression to deep narcosis. The OSHA PEL for this compound is 200 ppm. ACGIH recommends a TLV of 200 ppm.

Trichloroethylene (TCE) - A colorless, non-flammable liquid with a sweet odor like chloroform. Can be adsorbed through the skin. Inhalation and ingestion are also routes of exposure. Symptoms of exposure include headaches, dizziness, disturbed vision, nausea, vomiting, and eye irritation. Fatalities have occurred following severe, acute exposures. It has been known to cause cancer in laboratory animals. OSHA has established a PEL of 100 ppm; ACGIH recommends a TLV of 50 ppm, and a STEL of 200 ppm. Odor threshold is 50 ppm.

Vinyl Chloride - An easily liquified gas with a faintly sweet odor. It may affect the central nervous system, liver, respiratory system and lymphatic system. Symptoms of inhalation exposure to vinyl chloride at high concentrations can cause dizziness, anesthesia, lung irritation. Skin exposure can cause frostbite. It is a known carcinogen. OSHA has established a PEL of 1 ppm; the ACGIH recommends a TLV of 5 ppm.

Metals. Analysis of groundwater samples (July 10, 1984, by the FIT), particularly from well G103, reportedly revealed the presence of elevated concentrations of zinc, lead, and cadmium. Further investigation suggested metals concentrations in groundwater may be related to a deteriorating protective casing at this well.

Acute toxic effect from metals result from the inhalation of air or liquids containing the metals in very high concentrations. The symptoms of ingestion of excessive amounts of metals are those of food poisoning, with nausea, vomiting, abdominal pains, and, in certain cases, diarrhea.

Zinc - Zinc poses a potential health risk by inhalation of its oxide (ZnO). Some Zinc compounds have been found to cause skin ulcers and others present fire and explosion hazards. Care should be taken to prevent any skin contact with and/or

inhalation of dusts or liquids containing Zinc. The OSHA PEL for Zinc as ZnO is 5 milligrams per cubic meter of air.

Lead - Inorganic lead compounds enter the body primarily by inhalation and ingestion; only organic lead compounds are absorbed through the skin. Some of the early symptoms of lead poisoning are fatigue, sleep disturbance, headache, aching of bones and muscles. The OSHA PEL for lead as Pb (inorganic fumes and dusts) is 0.05 milligrams per cubic meter of air.

Cadmium - Inhalation of cadmium compounds at concentrations above 1 milligram Cd per cubic meter in air for 8 hours, or at higher concentrations for shorter periods, may lead to chemical pneumonitis, and in severe cases pulmonary edema. Symptoms of ingestion of liquids contaminated with cadmium are nausea, vomiting, abdominal pains, and sometimes diarrhea. A PEL of 0.1 milligrams per cubic meter of air for fumes and 0.2 milligrams per cubic meter of air for dust has been established by OSHA.

Refer to Appendix M - Chemical Hazard Evaluation Sheets for further information on these chemical hazards.

3.2 SITE PHYSICAL HAZARDS

3.2.1 Excavations

Excavation activities involve several risks to personnel involved in such activities. Personnel will refrain from entering excavations which would represent a confined or otherwise permitted-entry space. Subcontractors performing excavation have the responsibility of complying with OSHA 29 CFR 1926 (excavation standard) and any other applicable regulations pertinent to their expertise. Spotters will be used when personnel are performing associated tasks in the immediate area where excavation activities are occurring. Excavations which must remain open at the end of daily operations must be appropriately marked-off and signaled for hazard.

3.2.2 Hot and Cold Weather Considerations

Appendix D of this Plan, Temperature Stress, describes symptoms and responses for emergencies due to hot or cold exposure.

3.2.3 Use of Heavy Equipment

Activity around and use of heavy equipment present hazards to on-Site personnel in the normal operation of machinery. Personnel must engage in standard safe operating procedures in the operation of drill rigs, earth movers, and other heavy equipment. Refer to Appendix N - Subcontractor's Vehicle and Drill Rig Safety

Plan. Use caution when working around heavy equipment: a hard hat, safety glasses, and steel-toed boots should be worn within a 50-ft radius of heavy equipment. Hearing protection devices should be worn as necessary around operating heavy equipment. The work area must be controlled to prevent unauthorized personnel from entering the excavation area. There is to be no smoking in areas designated as "no smoking" or anywhere within the landfill refuse limits.

3.3 HAZARD RISK ANALYSIS

3.3.1 Job Tasks

The following tasks will be performed as part of the remedial investigation at the H.O.D. Landfill Site.

- Site Survey
- Soil borings, well installation
- Downhole geophysical logging
- Test Pit excavations
- Gas probe installation
- Soil/Groundwater Sampling
- Surface water/sediment sampling

Site Survey

- Potential Hazards: VOCs, combustible atmospheres, low-oxygen atmospheres, vinyl chloride, hydrogen sulfide, temperature stress and severe weather conditions.
- Hazard evaluation: Low to Moderate
- Principle Route of Exposure: Dermal contact and inhalation.
- Level of Protection: Level D with upgrade to Level D-Modified or Level C.
- Air Monitoring: Air Monitoring will be performed at the breathing zone every time soils or groundwater are disturbed for VOCs, combustible atmospheres, oxygen, hydrogen sulfide and hydrogen cyanide. If any reading above background is obtained on the organic vapor monitor, vinyl chloride colorimetric tubes will be used to verify the presence of vinyl chloride. Air monitoring will be performed in the breathing zone of site personnel. Actions levels for the various air monitoring equipment are given in Appendix I.

Air Monitoring will be conducted for the above mentioned contaminants using the following types of equipment:

<u>Contaminant</u>	<u>Equipment</u>
Volatile Organic Compounds	Photoionization Detector
Combustible Atmospheres	Multi-Gas Meter
Oxygen	Multi-Gas Meter
Hydrogen Sulfide	Multi-Gas Meter
Hydrogen Cyanide	Monitox
Vinyl Chloride	Colormetric Tubes

- **Special Considerations:** Work will be performed under the "buddy system". Protective equipment as prescribed in Section 9 will be worn. The Temperature Stress and Severe Weather SOPs (Appendix C and D respectively) will be followed. The HSO will clear utilities before drilling commences.

Soil Borings/Well Installation

- **Potential Hazards:** VOCs, combustible atmospheres, low-oxygen atmospheres, vinyl chloride, hydrogen sulfide, hydrogen cyanide, heavy metals, operating drilling equipment, temperature stress, severe weather conditions, noise and underground utilities.
- **Hazard Evaluation:** Moderate to High
- **Principle Route of Exposure:** Dermal contact and inhalation
- **Level of Protection:** Level D-Modified with upgrade to Level C or B.
- **Air Monitoring:** Air Monitoring will be performed at the breathing zone every time soils or groundwater are disturbed for VOCs, combustible atmospheres, oxygen, hydrogen sulfide and hydrogen cyanide. If any reading above background is obtained on the organic vapor monitor, vinyl chloride colorimetric tubes will be used to verify the presence of vinyl chloride. All health and safety air monitoring will be conducted in the breathing zone of site personnel. Action levels for the various air monitoring equipment are given in Appendix I.

Downhole Geophysical Logging

- **Potential Hazards:** VOCs, combustible atmosphere, low-oxygen atmospheres, hydrogen sulfide, hydrogen cyanide, vinyl chloride, temperature stress and severe weather conditions.

- Hazard Evaluation: Low to Moderate.
- Principle Route of Exposure: Dermal contact and inhalation.
- Level of Protection: Level D-Modified with upgrade to Level C or Level B.
- Air Monitoring: Air Monitoring will be performed before operations begin at each well location for VOCs, combustible atmospheres, oxygen, hydrogen sulfide and hydrogen cyanide. If any reading above background is obtained on the organic vapor monitor, vinyl chloride colorimetric tubes will be used to verify the presence of vinyl chloride. Air monitoring will be performed in the breathing zone and borehole of site personnel. Action levels for the various air monitoring equipment are given in Appendix I.
- Special Considerations: Protective equipment as prescribed in Section 9 will be worn. The Temperature Stress and Severe Weather SOPs (Appendix C and D respectively) will be followed.

Test Pit Excavations

- Potential Hazards: VOCs, Combustible atmospheres, low-oxygen atmospheres, vinyl chloride, hydrogen sulfide, hydrogen cyanide, heavy metals, operating backhoe, temperature stress, severe weather conditions, noise, underground utilities, excavation cave in.
- Hazard Evaluation: Moderate to High
- Principle Route of Exposure: Dermal contact and inhalation.
- Level of Protection: Level B.
- Air Monitoring: Air Monitoring will be performed at the breathing zone every time soils or groundwater are disturbed for VOCs, combustible atmospheres, oxygen, hydrogen sulfide and hydrogen cyanide. If any reading above background is obtained on the organic vapor monitor, vinyl chloride colorimetric tubes will be used to verify the presence of vinyl chloride. All health and safety air monitoring will be conducted at the perimeter of test pits, at ground level and in the breathing zone. Action levels for the various air monitoring equipment are given in Appendix I.

- **Special Consideration:** Care should be taken not to splash contaminated water/liquids on unprotected skin. Hooded tyvek with taping of gloves and disposable boot covers to the tyvek is required.
- **Hearing protection devices** should be worn around the backhoe. The backhoe is to be operated in a safe manner. The operator of the backhoe should comply with OSHA standards. Personnel will not enter any of the test pits. Samples should be obtained by using the backhoe. A spotter outside the Exclusion zone will monitor Level B operations at the test pit sites. Level B rescue equipment will be available for emergency situations.

Protective equipment as prescribed in Section 9 will be worn. The Temperature Stress and Severe Weather SOPs (Appendix C and D respectively) will be followed. The HSO will clear utilities before test pit excavations commence.

Gas Probe Installation/Leachate Piezometers

- **Potential Hazards:** VOCs, combustible atmospheres, low-oxygen atmospheres, vinyl chloride hydrogen sulfide, hydrogen cyanide, heavy metals, operating drilling equipment, temperature stress, severe weather conditions noise and underground utilities.
- **Hazard Evaluation:** Moderate to High
- **Principle Route of Exposure:** Dermal contact and inhalation
- **Level of Protection:** Level C with upgrade to Level B.
- **Air Monitoring:** Air Monitoring will be performed in the breathing zone every time soils or groundwater disturbed for VOCs, combustible atmospheres, oxygen, hydrogen sulfide and hydrogen cyanide. If any reading above background is obtained on the organic vapor monitor, vinyl chloride colorimetric tubes will be used to verify the presence of vinyl chloride.

Soil/Groundwater Sampling

- **Potential Hazards:** VOCs, combustible gases, low-oxygen atmospheres, vinyl chloride, hydrogen sulfide, hydrogen cyanide, temperature stress and severe weather conditions.
- **Hazard Evaluation:** Low to Moderate.

- Principle Route of Exposure: Dermal contact and inhalation.
- Level of Protection: Level D-Modified with upgrade to Level C.
- Air Monitoring: Air monitoring in the breathing zone will be performed every time soils or groundwater are disturbed. Monitoring for VOCs, combustible atmospheres, oxygen, hydrogen sulfide and hydrogen cyanide will be performed. If any reading above background is obtained with the organic vapor monitor, vinyl chloride colorimetric tubes will be used to verify the presence of vinyl chloride. Action levels for the various air monitoring equipment are given in Appendix I.
- Special Considerations: Protective equipment as prescribed in Section 9 will be worn. The Temperature Stress and Severe Weather SOPs (Appendix C and D respectively) will be followed.

Surface Water/Sediment Sampling

- Potential Hazards: VOCs, combustible atmospheres, low-oxygen atmospheres, vinyl chloride, hydrogen sulfide, temperature stress and severe weather conditions.
- Hazard evaluation: Low to Moderate
- Principle Route of Exposure: Dermal contact and inhalation.
- Level of Protection: Level D with upgrade to Level D-Modified or Level C.
- Air Monitoring: Air monitoring for VOCs, combustible atmospheres, oxygen, hydrogen sulfide and hydrogen cyanide will be performed in the breathing zone every time soils or groundwater are disturbed. If any reading above background is obtained on the organic vapor monitor, vinyl chloride colorimetric tubes will be used to verify the presence of vinyl chloride. Air monitoring will be performed in the breathing zone of site personnel. Action levels for the various air monitoring equipment are given in Appendix I.
- Special Considerations: Care should be taken not to splash contaminated water/liquids on unprotected skin. Hooded tyvek with taping of gloves and disposable boot covers to the tyvek is required.

Hearing protection devices should be worn around operating heavy equipment. Drilling equipment should be operated in a safe manner and

should be inspected to ensure it is in a safe condition. Personnel should be trained in the operation of the equipment and know safety rules that apply. Vehicle reverse alarms are required on all drilling rigs. Personnel should be familiar with emergency shutdown procedures. All work should comply with OSHA standards.

GENERAL INVESTIGATION MONITORING SAFETY RULES

4.1 GENERAL

An investigation approach has been prepared to address gaps in the existing Site data base and to provide adequate data to conduct a Risk Assessment and Feasibility Study. The Technical Scope (TS), Section 4 in the Preliminary Site Evaluation Report, provides a description of the rationale for and content of proposed RI/FS and also describes the goals and quality objectives of the RI data collection efforts.

4.2 DATA NEEDS

The Data Needs establish the objectives for data collection activities in the RI. Discussion of Data Needs for the RI were presented in Section 4, Technical Scope, of the Preliminary Site Evaluation Report.

Additional data collection activities will focus on physical site characterization, source characterization, definition of nature and extent of contamination and possible response actions.

The RI will be conducted in two phases. The Phase I RI will consist of source characterization and physical site characterization. Based on the results of the Phase I effort, a sampling/monitoring program will be established for each media of concern. Phase 2 RI activities will focus on describing contaminant migration pathways and characterizing the nature and extent of contamination, if any.

Phase 2 RI activities will include primarily field investigation and data analysis oriented toward potential migration pathway assessment and contaminant characterization.

The primary environmental concern at the Site is groundwater. Therefore, the hydrogeological investigation will include: drilling borings, installing monitoring wells in the surficial sand and deep sand and gravel, monitoring groundwater and surface water levels, and designing an appropriate groundwater sampling program.

4.3 AIR MONITORING PLAN

During the performance of the hydrogeological investigation air monitoring will be performed according to the air monitoring plan.

Air monitoring will be performed whenever any of the following situations arise:

- Work begins at different portions of the site
- New contaminants are noted
- A new/different phase of work is started
- Work is being performed in areas with obvious liquid contamination
- Intrusive activities

Conduct monitoring of the person collection samples:

- If samples are being collected in jars, use monitoring equipment to determine the level of contaminants in the breathing zone of the person collecting the samples.

Calibrate all monitoring equipment at the beginning and end of each work day. Instruments will be calibrated by the SSO according to the Warzyn Instrument Operating Procedure (IOP) specific to the instrument. In general the procedures involve using cylinders of calibration gases at known concentrations to calibrate the instrument. Calibration will be documented in the field logs. IOPs are found in Appendix K. When air monitoring is required, take area air samples at the following locations daily. Record time and results of monitoring:

- Upwind of work areas to establish background air contaminants.
- In support zone to check for contamination.

- Along decontamination line to check that decontamination workers are properly protected and on-site workers are not removing protective equipment in a contaminated area.
- Exclusion zone to verify level of protection and exclusion zone boundaries.
- Downwind of work area to track any contaminants leaving site.

4.4 AIR MONITORING EQUIPMENT

- An HNu or OVM Photoionizer (with 11.7 ev lamp) will be used by the Site Safety Officer for monitoring of air quality at the work sites. This will be done to assess the relative levels of organic airborne contaminants, aiding in site assessment.
- An Industrial Scientific Meter will be used to detect any presence of explosive landfill gases and determine available oxygen and hydrogen sulfide levels.
- A Monitox - hydrogen cyanide monitor will be used to monitor for the presence of hydrogen cyanide.
- Selected colormetric tubes will be available for utilization in testing for the presence of particular volatile toxic compounds such as vinyl chloride, and to verify the presence of hydrogen sulfide and hydrogen cyanide.

Action levels for the above monitoring are presented in Warzyn's Field Standard Operating Procedures, Appendix I.

4.5 GENERAL SITE HEALTH AND SAFETY RULES

All personnel must be familiar with standard operating safety procedures and any additional instructions and information contained in the Site Safety Plan. All personnel must adhere to the information contained in the Site Safety Plan. General site health and safety rules can be found in Appendix E.

All personnel going on-site must be adequately trained and thoroughly briefed on anticipated hazards, equipment to be worn, safety practices to be followed, emergency procedures, and communication. All personnel must read the Health and Safety Plan prior to beginning of project work.

Site health and safety briefings must be conducted on a daily basis or as necessary, as changes in site conditions occur. Health and Safety Plans will be given to contractors and subcontractors to become familiar with the hazards at the site. The Health and Safety Plan will be amended as site conditions change.

DECONTAMINATION PROCEDURES

5.1 PERSONNEL DECONTAMINATION

Every attempt will be made to prevent direct contact with contaminated materials. The sequential removal and decontamination or disposal of potentially contaminated personal protective equipment is required to prevent the migration of contaminants to support zone where personal protective equipment is downgraded, or to the rest of the Site. The decontamination pad area will be constructed on the top of the landfill near the existing access road and leachate manholes. Personal decontamination areas will be located at proposed soil borings and well locations (Investigation Points). Refer to Figure 3, Decon Pad Location Map in this HASP, and Figure F10, Proposed Investigation Points located in the Work Plan. Standard Operating Procedures for Decontamination can be found in Appendix F.

All personal equipment and vehicles coming into direct contact with contaminated materials or areas will be required to go through decontamination procedures. Rinse collection will include personal decontamination and decontamination pad waters. These waters will be temporarily contained in 55-gallon drums and included as part of the leachate water which will be treated off-site at a wastewater treatment facility.

All site personnel involved with work activities in the contamination zones will abide by the aforementioned decontamination procedures. Contamination and contamination reduction zones will be established each time that intrusive operations initially occur at a given location.

5.2 EQUIPMENT DECONTAMINATION

All equipment entering the contamination zone and directly contacting the surface of the ground or any contaminated materials must follow the decontamination procedures described below.

- All equipment decontamination is to occur on-site.
- Gross contamination will be removed with a brush and a phosphate free detergent solution in the contamination zones.
- Steam cleaning will follow at the designated equipment decontamination station.
- Personnel will wear Level D-Modified Protection while steam cleaning to prevent dermal contact with contaminated liquids. Use extra care to prevent contact with steam or hot surfaces or materials.
- Any equipment left on-site at the end of the day in a contaminated status will be left on the contaminated portion of the equipment decontamination station.

All sampling equipment, including spilt-spoons, shelby tubes, augers, trowels, spoons, and water sampling equipment, will be decontaminated after each use. Special care will be taken that all split-spoons and shelby tubes are thoroughly decontaminated prior to use at the site.

Decontamination of sampling equipment must include a wash with a phosphate free detergent solution and a triple rinse with distilled water.

Bags of used personal protective equipment will be stored on-site in a covered roll-off container.

Prior to drill rigs or other heavy equipment leaving the site, such equipment will undergo full decontamination procedures as described in this section of the Health and Safety Plan.

DISPOSAL OF INVESTIGATION DERIVED WASTE MATERIALS

All investigative wastes will be managed as stated in the sampling and analysis Plan (SAP, Appendix A) of the H.O.D. Landfill quality assurance project plan (QAPjP), consistent with the "Guide to Management of Investion-Derived Wastes", U.S. EPA Publication 9345.3-03FS, April 1992.

Used wash water generated at the Personnel Decontamination Area will be temporarily containerized and disposed with the leachate water as described further in this section.

Personal protective equipment will be bagged, stored on-site in a designated covered roll-off container for disposal.

Water from equipment decontamination will be routed to an existing on-site manhole, and immediately pumped from the manhole into the temporary leachate tanker and disposed of with the extracted leachate. Waste liquids from the development or purging for sampling of monitoring wells will be collected and disposed with leachate. Leachate is derived from the landfill and will be disposed off-site for wastewater treatment along with waste liquids and water from equipment decontamination.

Soils from drill cuttings will be screened with a PID. Soils with a PID reading less than 5 ppm will be considered non-impacted and spread near the boring. Soils with a PID reading greater than 5 ppm will be stored on-site in a covered roll-off container and handled as part of the final remedy. No other wastes will be stored in the roll-off container which has been designated for contaminated soil disposal.

THERMAL STRESS CONDITIONS

Special care will be taken to insure that work crew personnel do not suffer physical distress as a result of working under hot or cold weather conditions. This is particularly a concern where work activity is conducted at Level C or Level B personal protection during warm or hot weather. Temperature stress is discussed in Appendix D. Guidelines presented in that discussion will be generally followed. Individual physical differences and varying susceptibilities to heat stress will be considered in scheduling work activities and break periods.

WORK LIMITATIONS

In general, all field activities will be restricted to daylight hours. No drilling or other heavy machinery will be operated after daylight hours. High winds or lightning conditions will necessitate shut-down of drilling operations. In the event of rain, the Site Safety Officer will evaluate the need for suspending drilling operations. The Site Safety Officer and Site Supervisor will be responsible for determining continuance/shut-down of field activities during adverse weather conditions. Severe Weather Standard Operating procedures are found in Appendix C.

PERSONAL PROTECTIVE EQUIPMENT

Personnel performing active Site duties must use the appropriate ensemble of personal protective equipment, unless performing oversight duties from upwind support areas. Changes in levels of protection may be initiated by the SSO, but downgrades in level of protection must involve consultation with the (HSM).

9.1 PROTECTIVE LEVELS FOR SPECIFIC TASKS

Initial protection levels for specific field tasks are described below.

Site Survey - Surveying personnel will wear Level D protection.

Surface Water and Sediment Sampling - Sampling personnel will begin activities at Level D with possible upgrade to Level D-Modified or C as determined by the Site Safety Officer based upon site conditions and air monitoring results.

Soil Borings/Well Installation - Level D-Modified protection will be worn during drilling of soil boring or installation of wells into areas other than the landfill, such as perimeter borings and monitoring wells. Possible upgrade to Level C or B will be determined by the Site Safety Officer as appropriate with air monitoring results and changing site conditions.

Installation of Landfill Gas Probes/Leachate Piezometers - Activity will be conducted at Level C with possible upgrade to Level B as determined by the Site Safety Officer as appropriate with air monitoring results and changing site conditions.

Sampling of Groundwater Monitoring Wells and Leachate Wells - A minimum of Level D-Modified protection will be worn for sampling groundwater monitoring wells and leachate wells, with possible upgrade to Level C as determined by the Safety Officer where appropriate with monitored conditions.

Downhole Geophysical Logging - Level D modified will be initially worn with possible upgrade to Level B or as determined by the Site Safety Officer based upon air monitoring results and changing site conditions.

Test Pits Excavation - Level B will be required during the excavation of the test pits.

All project personnel working immediately adjacent to operating drill rig must not wear loose clothing. If wearing Tyvek, it must be securely taped at seams and pulled flat to body with extra taping. Be alert at all times when working adjacent to or directly with drilling equipment. Never directly contact any rotary auger.

9.2 PERSONAL PROTECTION LEVELS

Personal Protective Equipment (PPE)

Level D - Level D is to be worn during activities which do not suggest any initial respiratory or dermal health hazards. The following list outlines the personal protective equipment to be utilized for Level D:

Required PPE:

- Steel-toe/steel-shank work boots or steel-toe/steel-shank neoprene boots
- Work uniform
- Eye protection (safety glasses and side shields, with or without face shield)
- Hard hat

Optional PPE - Use as needed:

- Hearing protection

Level D - Modified - Level D - Modified is to be worn during activities which do not suggest any initial respiratory hazards, but where dermal protection is warranted. The following outlines this level of protection:

Required PPE:

- Steel-toe/steel-shank work boots with latex overboots or steel-toe/steel-shank neoprene boots
- Polyethylene-coated Tyvek coveralls
- Nitrile or neoprene outer gloves
- Vinyl inner gloves
- Hard hat
- Eye protection (safety glasses and side shields, with or without faceshield)

Optional PPE - Use as needed:

- Hearing protection

Level C - Level C should be worn when the criteria for using air-purifying respirators are met, and a higher level of skin protection is needed. The following outlines this level of protection:

Required PPE:

- Steel-toe/steel-shank work boots with latex overboots or steel-toe/steel-shank neoprene boots
- Polyethylene-coated Tyvek coveralls
- Nitrile or Neoprene outer gloves
- Vinyl inner gloves
- Full-facepiece air-purifying respirator
- GMC-H respirator cartridges
- Hard hat

Optional PPE - Use as needed:

- Hearing protection

Level B - Level B protection is worn when the highest level of respiratory protection is needed and higher level of skin protection is required. Level B is the primary level of choice when encountering unknown environments.

Required PPE:

- Steel-toe/steel-shank work boots with latex overboots or steel-toe/steel-shank neoprene boots
- Polyethylene-coated Tyvek coveralls
- Nitrile or Neoprene outer gloves
- Vinyl inner gloves
- Positive-pressure self-contained breathing apparatus (SCBA), or airline respirator with 5 minute escape bottle.
- Hard hat

Optional PPE-Use as needed

- Hearing protection

The Site Safety Officer and the Site Supervisor have the authority and responsibility to upgrade levels of protection and, when necessary, shut down operations. Downgrades in levels of protections should be made with the approval of Warzyn's Health and Safety Manager.

PERSONNEL RESPONSIBILITIES AND TRAINING

10.1 SITE ORGANIZATIONAL STRUCTURE

The organization chart for the H.O.D. Landfill Site remedial investigation (RI) is shown in Figure 1. The health and safety organization chart for the field investigative work to be conducted during the RI is shown in Figure 2.

10.2 KEY PERSONNEL

The Site Health and Safety Officer and Site Supervisor will be assigned prior to the start of investigative field activities. The Site Safety Officer and the Site Supervisor have the authority and responsibility to upgrade levels of protection and, when necessary, shut down operations. Downgrades in levels of protection should be made with the approval of Warzyn's Health and Safety Manager.

10.3 PERSONNEL ROLES

Project Manager - The project manager must oversee operations and verify that all health and safety procedures and requirements are met.

Site Health and Safety Officer - The Site Health and Safety Officer (HSO) is responsible for interfacing with Warzyn's Health and Safety Manager.

The HSO may be required to perform various types of area or personnel monitoring for purposes of verifying worker exposure and proper selection of personal protective equipment. The HSO is to be consulted before any changes in the recommended procedures or levels of protective clothing are made. The HSO

implements all health and safety policies according to the H&S Plan; responds to site emergencies and contacts the appropriate emergency personnel and informs immediately Warzyn's Health and Safety Manager. The HSO must be at the site at all times; should he/she need to be away from the site, the project manager will appoint another site safety officer.

Site Supervisor - The site supervisor is the on-site coordinator and overseer of operations. It is his/her duty to maintain site security, supervise the laborers and technicians, and implement all procedures (health and safety, decontamination, and protective equipment).

10.4 EMPLOYEE EDUCATION AND TRAINING

All operational employees participate in routine health and safety education and training programs. These programs, directed by the Warzyn Corporate Health and Safety Manager, are designed to provide these employees with a thorough knowledge of hazardous materials, health and safety hazard potentials and compliance with federal OSHA 29 CFR 1910.120(e). These programs include 40 hours initial instruction, 8 hours refresher training, supervisor's additional 8 hours specialized training, and EPA requirements. In addition, 3 days of field experience under a trained, experienced supervisor are required. At a minimum, this training includes the following:

- General Safety Rules
- Basics of Chemistry
- Basics of Toxicology/Physiology
- Hazardous Materials (types/characteristics)
- Hazard Communication Information
- Respiratory Protection
- Respirator Training
- Chemical Protective Clothing
- Decontamination Procedures/Personal Hygiene
- Fire Prevention/Protection
- First Aid/CPR
- Atmospheric Testing/Sampling Procedures
- Emergency Response Procedures
- Federal and State Regulations
- Electrical Hazards

Prior to beginning on-site project activities or prior to changes in the phases of site work, the site health and safety officer will verify that all site personnel have reviewed the site Health and Safety Plan. Standard operating procedures and safe

work practices are discussed with these personnel. These orientations will be repeated for newly assigned project personnel as such personnel arrive on-site for later phases of project work. The Site HSO's name will be given to all workers at the Site and it will be posted along with hospital route and map information. In case of his/her absence, the project manager will appoint a replacement.

CONFINED SPACE ENTRY

Based on the work scope described in the Work Plan, confined space entry work is not anticipated. Should the scope of work change or unexpected site conditions develop which necessitate confined space entry, Warzyn personnel will follow the procedures and protocols contained in Appendix J of the Health and Safety Plan. A confined space entry permit is required to be completed and posted at the entrance of the confined space. These procedures and protocols address the following categories of concern with relation to permitted, confined-space entry work:

- Application of Warzyn confined space entry procedures
- Training of individuals involved
- Air monitoring protocols within confined space
- Additionally required air monitoring instrumentation (if applicable)
- Additional PPE requirements (if applicable)

MEDICAL SURVEILLANCE

Warzyn employees involved with this project work will participate in a medical surveillance program under the direction of an Occupational Physician, following requirements under 40 CFR 1910.120 (f). This program includes baseline, annual, and exit examinations. The typical annual physical examination protocol includes:

- Comprehensive Health and Exposure History
- Physical Evaluation
- Urinalysis
- Stool Occult Blood
- Blood Chemistry Profile
- Hematology Profile
- Pulmonary Function Testing
- Audiometry
- Vision Testing

Additionally, each Warzyn employee is evaluated to determine if they are physically able to perform work while using respiratory protective equipment in compliance with 29 CFR Part 1910.134 and ANSI Z88.2 - 1980.

At the completion of the exam, the physician provides Warzyn and the employee with a written evaluation including:

- Physician's opinion on the employee health and medical condition to perform work at hazardous waste site operations.
- Recommended limitations upon the employee assigned work.
- The results of the medical examination and tests.

- A statement that the physician has informed the employee of any medical conditions which require further examination or treatment.

Recordkeeping

All medical records are kept for the duration of employment plus thirty years.

Each employee's record contains:

- Name and social security number
- Physician's written opinions, recommended limitations, and results of examination and tests
- Any employee medical complaints related to exposure to hazardous substances

Employees may access their medical records by contacting the Health and Safety Manager.

SITE SECURITY AND CONTROL ZONES

Exclusion zones will be set up at each borehole or other areas of active intrusive operations, which will include a circumferential buffer zone of 25-foot radius. These zones are restricted to essential operators and monitoring personnel only. Personnel decontamination (or contamination reduction) zones will be constructed adjacent to each contamination zone. One equipment decontamination station will be constructed at an operationally practical location which minimizes possible cross-contamination of support areas. All zones will be clearly defined with physical demarcation devices in accordance with prudent practices and applicable guidelines. Only personnel involved in project work or oversight will enter zones other than support zones during these project operations. Project personnel on-site each day will check in with appropriate facility management as applicable, and will log in and log out in the site log book. All project personnel will enter and leave the site by the facility main gate. The site is secured by a fence and locked gate. The gate key is available from Waste Management of Illinois, Inc. All boreholes or any excavations which are not "backfilled" or "plugged" at the end of the work day must be clearly marked.

CONTINGENCY PLAN/ EMERGENCY RESPONSE

14.1 EMERGENCY ACTION - STANDARD OPERATION PROCEDURES

- Name, address, and telephone number of the nearest medical treatment facility will be conspicuously posted. A map and directions for locating the medical facility, will be readily available. This route will be verified by the HSO or alternate prior to beginning work activities.
- Telephone numbers and procedures for obtaining ambulance, emergency, fire and police services will be conspicuously posted.
- An emergency eye wash fountain, toilet facilities and first aid equipment shall be readily available on-site.
- Project personnel will be familiarized with emergency routes of egress and assembly points. (Only route of egress is through the main entrance located at the southwest corner of site.)
- Every attempt to rapidly identify substances to which the worker has been exposed shall be made. This information will be given to medical personnel in the event of an emergency.
- Procedures for decontamination of injured workers and preventing contamination of medical personnel, equipment, and facilities shall be communicated to workers.
- Warzyn will have personnel on-site who are trained and certified in first aid and CPR.

- Sufficient water and/or dry chemical fire extinguishers and neutralizing agents will be maintained on site to cope with any situation until emergency services can arrive.

14.2 EMERGENCY ACTIONS

Should conditions exist which cause the cessation of work, Warzyn personnel shall immediately leave the work area and perform decontamination in the nearest safe location. The Health and Safety Coordinator, Project Manager, or Corporate Health and Safety Manager shall be immediately telephoned to determine further appropriate actions once the area and personnel are secure and stable. Any necessary medical attention, beyond first aid, is to be requested from one of the emergency facilities listed under "Emergency Contact Numbers" in this document. In the event of a fire or explosion, and/or evacuation, the procedures in Appendix G should be followed.

14.3 MEDICAL EMERGENCIES

Anyone being transported to a clinic or hospital for treatment will have accessibility to information on any potential chemical(s) to which they could have been exposed at the site. Toxicological information and/or specific medical records may be secured through the Warzyn Health and Safety Manager or from Warzyn's medical consultant in the event of a medical emergency. If determined as prudent or absolutely necessary, first aid should be administered while waiting for arrival of emergency medical services. Warzyn personnel trained and certified in first aid and CPR methods will be on-site to deliver such care in an emergency.

14.4 GENERAL ON-SITE FIRST AID

The following discusses general on-site First Aid procedures for exposure to contaminants on-site:

- **Contaminated Material in Eyes** - wash with copious amounts of water for at least 15 minutes. Lift upper and lower lids occasionally. Seek medical attention immediately. (Eye wash will be available on-site).
- **Contaminated Materials Contact Skin** - For organic materials, promptly wash area with soap or mild detergent and water. For corrosive materials, flush with water for at least 5 minutes. Do not rub.

Check for signs of skin irritation. Seek medical attention if unusual appearance of skin or sensation is noted.

- **Contaminated Materials Penetrate Protective Clothing** - discard protective clothing and underlying clothing. Wash skin as described above. Confer with HSO in selection of new protective clothing.
- **Inhalation of Contaminated Air** - move person to well ventilated area at once. If individual is not noticeably effected, and has no side effects after 15 minutes, returning to work is allowed providing the work area is no longer contaminated. If individual has not fully recovered, continue to monitor for 15 to 20 additional minutes and seek medical attention if necessary. Use artificial respiration if breathing has stopped. In such instances, seek medical attention after victim has resumed breathing. If possible have someone seek medical attention while person is being resuscitated.
- **Ingestion of Contaminated Materials** - flush mouth with water, being careful not to swallow. Contact local poison center (see telephone number in Emergency Response and Information section). When called for, induce vomiting and give fluids (preferably water) to drink. (DO NOT induce vomiting or give fluids to any unconscious persons). Seek medical attention promptly.

If at any time, personnel feel fatigued, dizzy, nauseous, or experience headaches, they are to be moved to a well ventilated area and allowed to rest for 15 to 30 minutes. If symptoms do not subside, seek medical attention. Should personnel exhibit symptoms of temperature stress, follow the guidelines for treatment contained in Appendix D of this plan.

14.5 ON-SITE COMMUNICATION SYSTEM

On-site communication procedures will be established in the field during the initial site briefing or whenever there is a change of site personnel. All emergency signals will be designated and discussed during such briefing. All employees will be made aware of exit routes and assembly points to be used in the event of an emergency. A telephone will be accessible to site personnel during all project field activities defined under the scope of work.

14.6 WORK SITE EMERGENCY PROCEDURES

In the event of a medical emergency at a work site, work crew personnel will act quickly and reasonably to remedy the situation. The Site Health and Safety Officer shall give directions as to how to proceed. If the HSO is incapacitated, the alternate HSO will direct necessary first aid and contact the appropriate local emergency response agency.

Any rescue attempts are to be directed by the HSO, or a designated alternate. Under no circumstances is a rescue attempt to be made without the proper personal protective equipment (PPE). Any rescuer going into an exclusion zone should have a level of protection equal to or greater than that worn by the victim.

14.7 EMERGENCY EQUIPMENT

The following emergency equipment shall be maintained at the site of active operations, at the perimeter of the exclusion zone (within 100 feet or 10 second access time).

- Fire Extinguisher
- Eye Wash
- First-Aid Kit
- 5 Gallons of Fresh Water (for flushing of skin, general washing)

First Aid Kits. First Aid Kits approved by Warzyn's medical consultant will be on-site near the site of active operations. First Aid Kits include:

- Sterile gauze
- Individual bandaids
- 3" to 4" Ace wraps
- Tape
- Tweezers
- Bandage scissors
- Non-sterile gauze
- Hydrogen peroxide
- Snake bite kit
- Inflatable splint
- Eyesaline
- Mylar blanket
- Cold packs
- Hot packs
- Aspirin/Tylenol

- CPR-mouth shields
- Disposable gloves
- Goggles
- Disposable garment
- Face mask

14.8 EVACUATION ROUTES

Evacuation routes shall be established and updated as necessary during all phases of project work. Evacuation should be conducted immediately, without regard for equipment, under conditions of extreme emergency.

Personnel should preferably exit out through the decontamination station. Personnel should decontamination if possible; otherwise, doff PPE in a predescribed manner. If exit must be made from alternate exit personnel shall doff PPE before leaving the site.

14.9 EMERGENCY DECONTAMINATION

Primary concern: Prevent severe injury or loss of life.

When is decontamination to be delayed? If immediate medical treatment is required to save a life, delay decontamination until the victim is stabilized.

When is decontamination to be performed immediately?

- If decontamination can be performed without interfering with essential life-saving techniques or first aid.
- If a worker has been contaminated with an extremely toxic or corrosive material which could cause severe injury or loss of life.
- **Heat-related illnesses:** Remove protective clothing from victim as soon as possible. Treat victim for heat exhaustion or heat stroke as appropriate to the symptoms exhibited by the victim. Refer to Appendix D.
- **Cold-related illnesses:** Remove outer layer of clothing upon entering sheltered area with adequate heat. If clothing is wet, replace all such clothing with dry clothing. Allow body temperature to warm up slowly. If symptoms of hypothermia exist, give no food or drink. Monitor

person closely. If frostbite is evident, warm affected parts in warm water (100-105 degrees Fahrenheit). Loosely wrap affected body parts with sterile gauze.

14.10 EMERGENCY CONTACT NUMBERS

Antioch Fire Department (Ambulance).....	911
Antioch Police.....	911
St. Therese Area Treatment Satellite.....	(708) 356-6600
IEPA - Land Pollution Control Division.....	(217) 782-6761
IEPA Emergency Removal Unit.....	(217) 782-3637
Illinois Emergency Service Disaster Agency.....	(800) 782-7860
National Poison Center.....	(800) 942-5969
National Response Center.....	(800) 424-8802
CHEMTREC.....	(800) 424-9300
U.S. Environmental Protection Agency	
Emergency Environmental Response (Chicago).....	(312) 353-2318
Hazardous Waste Hotline.....	(800) 621-3191
Rich Weber, Project Manager - Warzyn Inc.	
Office	(414) 359-1144
Erik A. Goplin, Warzyn Health and Safety Manager	
Office	(608) 274-0558
Steve Chillson, Site Safety Officer (SSO)	
Office	(708) 691-5033
Al Schmidt, Remedial Investigation Leader	
Office	(708) 691-5115
Site Trailer	To be added

Hospital Address:

St. Therese Area Treatment Satellite
37809 North Route 59
Lake Villa, Illinois 60046

14.11 ACCIDENT REPORTING

All accidents should promptly be reported to the Warzyn Health and Safety Manager and an Accident/Incident Investigation Report completed. Include detailed descriptions of the accident including: time/date of accident completed, who was involved, actions taken, emergency services contacted, causes and suggestions to prevent similar accidents in the future. The Health and Safety Manager will continue investigating accidents and make the necessary reports to the appropriate agencies.

PMS/mj/SJC/GEP/AJS
[C111 651 96]

Project Organization Chart

H.O.D. Landfill RI/FS

Antioch, Illinois

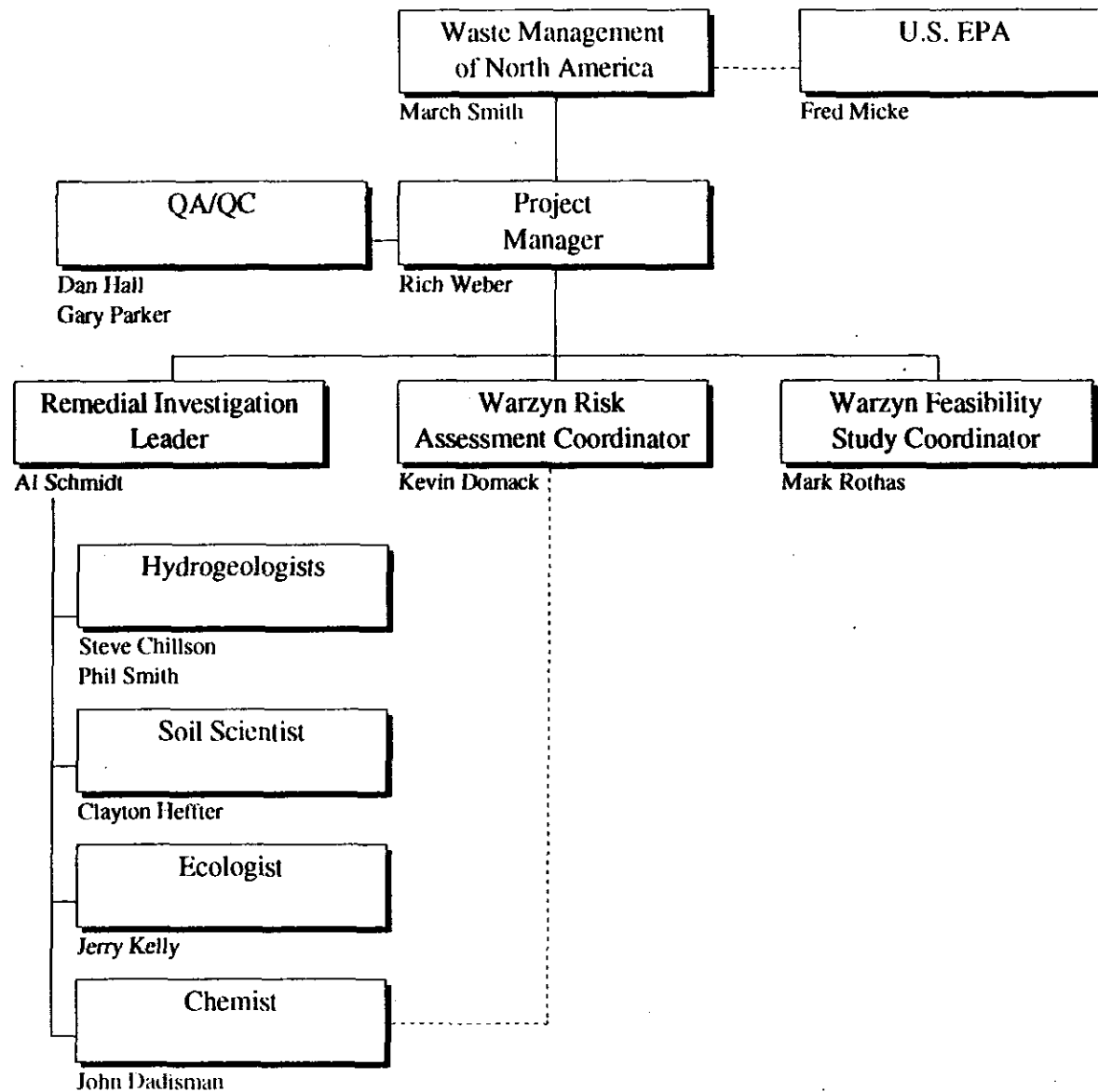


FIGURE 1

Health & Safety Organization Chart
H.O.D. Landfill RI/FS
Antioch, Illinois

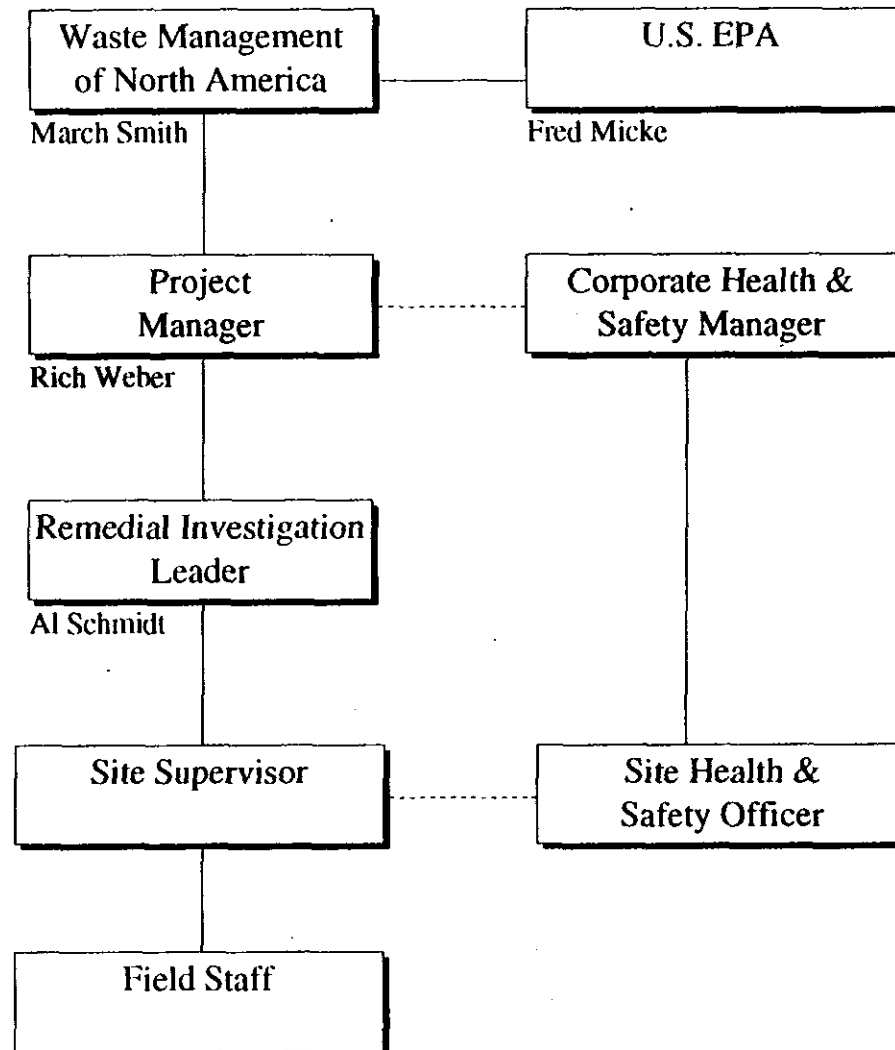


FIGURE 2

A
SITE MAPS

FIGURE 1

SITE LOCATION MAP

SITE LOCATION MAP

Management Review
Other

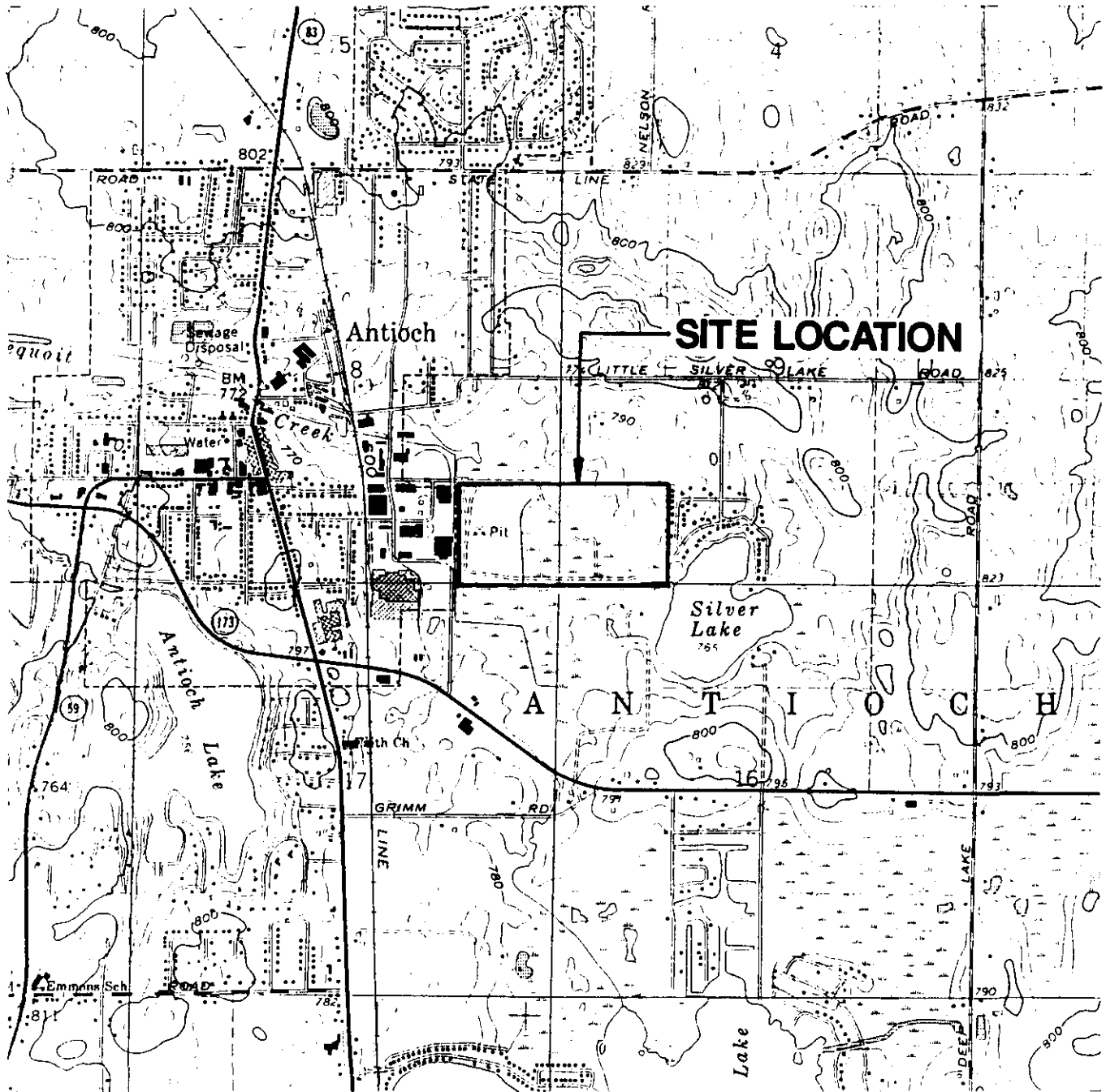
9/10/92

Technical Review
Project Manager

9/10/92

Graphic Standards
Lewi Professional

QUALITY CONTROL



NOTES

1. BASE MAP DEVELOPED FROM THE ANTIOCH, ILLINOIS 7.5 MINUTE USGS TOPOGRAPHIC QUADRANGLE MAP DATED 1960, PHOTOREVISED 1972.

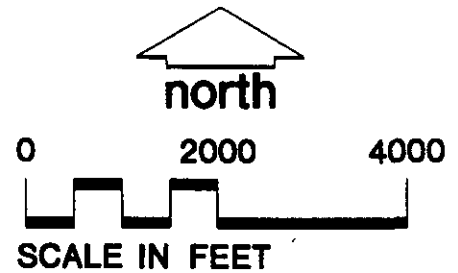


FIGURE 1

Developed By: TB
Drown By: DLL
Approved By: *Don E. Parker* Date: 9/10/92
Reference:
Revisions:

SITE LOCATION MAP

HEALTH AND SAFETY PLAN
H.O.D. LANDFILL
ANTIOCH, ILLINOIS

Drawing Number

6095300 A1



FIGURE 2

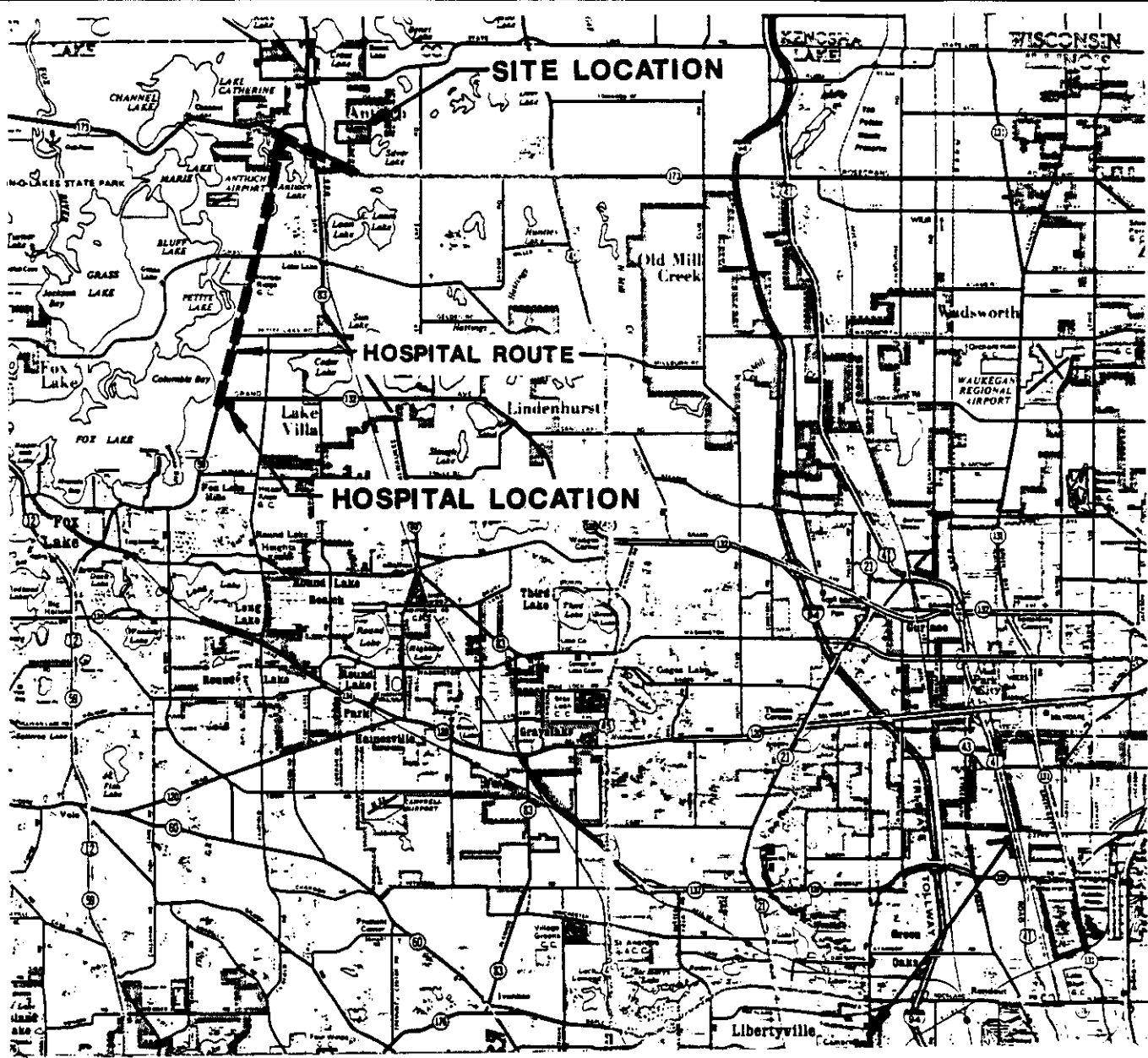
HOSPITAL ROUTE MAP

Management Review
Other

Technical Review
Project Manager A.J.S.

Graphic Standards D.L.L.
Lead Professional T.B.

QUALITY CONTROL



DIRECTIONS FROM SITE TO HOSPITAL
TAKE McMILLAN ROAD SOUTH TO 173. TAKE 173 WEST (RIGHT) TO ROUTE 59. TAKE ROUTE 59 SOUTH (LEFT) APPROXIMATELY 4.5 MILES TO ST. THERESE AREA TREATMENT SATTELITE ON EAST (LEFT) SIDE OF ROUTE 59 JUST SOUTH OF ROUTE 132 (GRAND AVENUE). USE SOUTH ENTRANCE.



north
NOT TO SCALE

HOSPITAL ADDRESS
ST. THERESE AREA TREATMENT SATTELITE
37809 NORTH ROUTE 59
LAKE VILLA, ILLINOIS 60046
TELEPHONE: (708) 356-6600

FIGURE 2

Developed By: TB	Drawn By: DLL
Approved By: <i>Alan J. Schmidt</i>	Date: 3/23/93
Reference:	
Revisions:	

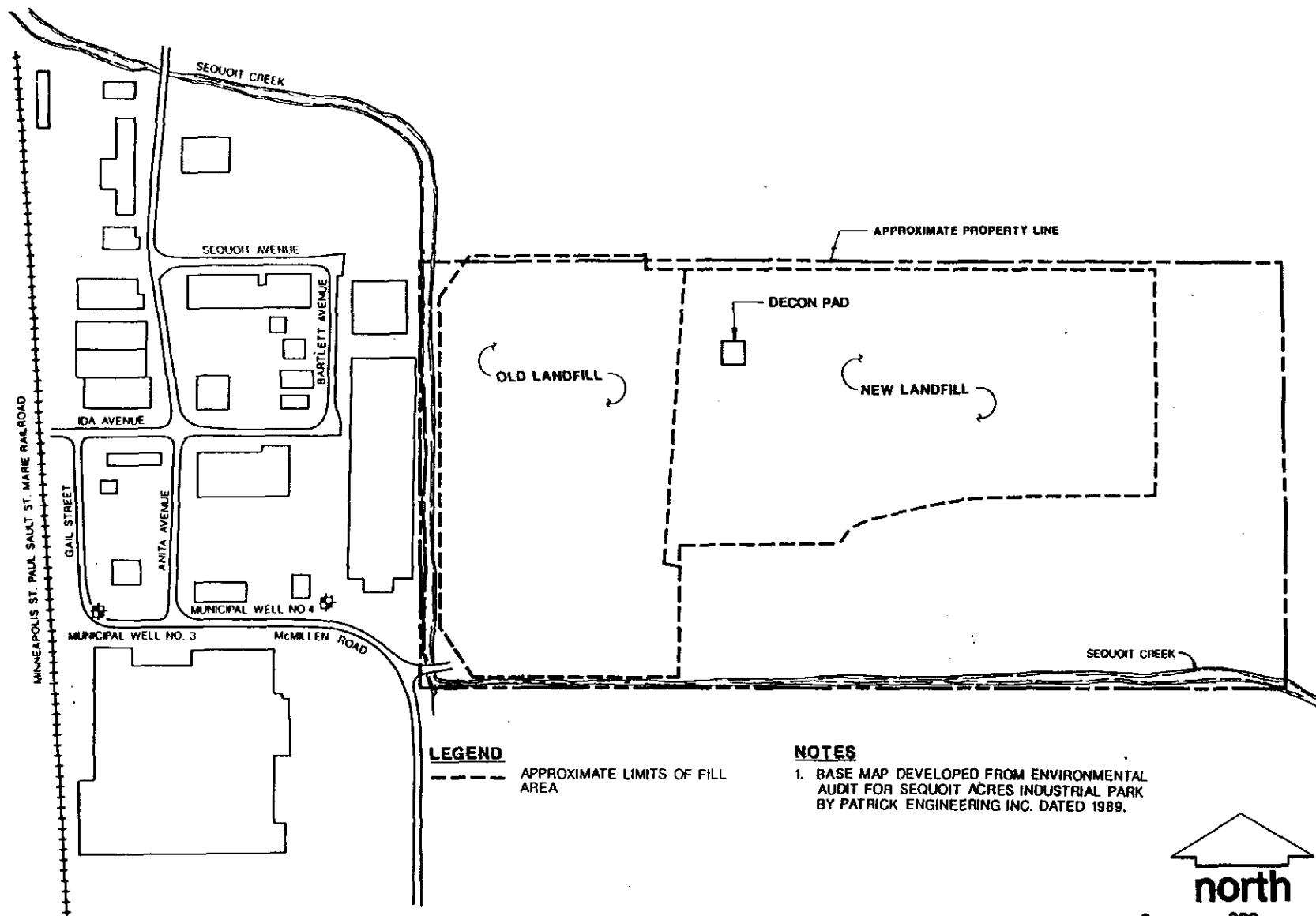
HOSPITAL ROUTE MAP
HEALTH AND SAFETY PLAN
H.O.D. LANDFILL
ANTIOCH, ILLINOIS

Drawing Number	6095300	A2
		

WARZYN INC.

FIGURE 3

DECON PAD LOCATION



LEGEND

--- APPROXIMATE LIMITS OF FILL AREA

NOTES

1. BASE MAP DEVELOPED FROM ENVIRONMENTAL AUDIT FOR SEQUOIT ACRES INDUSTRIAL PARK BY PATRICK ENGINEERING INC. DATED 1989.

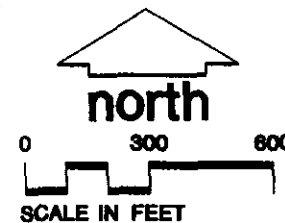


FIGURE 3

B

HEALTH AND SAFETY COMPLIANCE
AGREEMENT

NAMES AND SIGNATURES

All Warzyn employees working on or visiting this site are to sign below, indicating that they have read this Site Health and Safety Plan (SSP), understand its contents, have been given opportunity to discuss its contents with the Site Safety Officer (SSO) and agree to abide by its requirements.

The supervisors of all sub-contractors working under this SSP are to sign below, indicating that they have read this Site Health and Safety Plan (SSP), understand its contents, have been given opportunity to discuss its contents with the Site Safety Officer (SSO) and agree to abide by its requirements and enforce compliance with the SSP among their work crews.

[illegible]

C

SEVERE WEATHER

C

SEVERE WEATHER

When projects are conducted outside, the potential for severe weather must be considered. Thunderstorms, tornados and winter storms can develop quickly, jeopardizing your safety. The following emergency procedures are to be followed in the event of severe weather.

THUNDERSTORMS AND LIGHTNING

Monitor weather conditions at all times while working. At a sign of an impending storm - increased cloudiness, darkened skies, increased wind - listen to a radio for the latest weather information.

When a thunderstorm accompanied by lightning is in the project area, cease work immediately. All powered equipment, such as drill rigs, are to be shut down.

Seek shelter inside nearby buildings or trailers. If there are no buildings on nearby, seek shelter inside your vehicle.

If you are caught outside, do not stand beneath tall, isolated trees or telephone poles. Avoid areas projecting above the landscape such as hill tops. In open areas, go to a low place such as a ravine or valley. Stay away from open water, metal equipment, wire fences and metal pipes. If you are in a group of people in the open, spread out, staying several yards apart.

If you are caught in a level field or open area far from shelter and you feel your hair stand on end, lightning may be about to strike you. Drop to your knees and bend forward, putting your hands on your knees. You should minimize the body area in direct contact with the ground; **DO NOT LIE FLAT ON THE GROUND.**

If someone has been struck by lightning, monitor life signs and begin administering mouth-to-mouth resuscitation or cardiopulmonary resuscitation as needed. Send for help.

Check conscious victims for burns, especially at the fingers and toes and next to buckles and jewelry. Administer first aid for shock. Do not let the victim walk around.

TORNADOS

Tornados usually develop from thunderstorms and normally occur at the trailing edge of the storm. Most tornados occur in the months of April, May, June, and July in the late afternoon and early evening hours.

When storms are predicted for the project area, monitor weather conditions on a radio. A tornado watch is issued when favorable conditions exist for the development of a tornado. A tornado warning is issued by the local weather service office whenever a tornado has actually been sighted or is strongly indicated by radar.

If a tornado warning is issued, seek shelter immediately. If there are permanent buildings located on site, go there immediately, moving toward interior hallways or small rooms on the lowest floor.

If a tornado warning is issued and you are in a vehicle or a site trailer, leave and go to the nearest building. If there are no buildings nearby, go in the nearest ditch, ravine or culvert, with your hands shielding your head.

If a tornado is sighted or a warning issued while you are in open country, lie flat in a ditch or depression. Hold onto something on the ground, such as a bush or wooden fence post, if possible.

Once a tornado has passed the site, site personnel are to assemble at the designated assembly area to determine if anyone is missing. Administer first aid and seek medical attention as needed.

WINTER STORMS

When snow or ice storms are predicted for the project area, site personnel should monitor weather conditions on a radio. A winter storm watch is issued when a

storm has formed and is approaching the area. A winter storm warning is issued when a storm is imminent and immediate action is to be taken.

When a storm watch is issued, monitor weather conditions and prepare to halt site activities. Notify the project manager of the situation. Seek shelter at site buildings or leave the site and seek warm shelter.

If you are caught in a severe winter storm while traveling, seek warm shelter if road conditions prevent safe travel.

If you are stranded in a vehicle during a winter storm:

- STAY IN THE VEHICLE, disorientation comes quickly in blowing and drifting snow.
- Wait for help.
- Keep a window open an inch or so to avoid carbon monoxide poisoning.
- Run the engine and heater sparingly.
- Keep watch - do not let everyone sleep at the same time.
- Exercise occasionally.

D

TEMPERATURE STRESS

D

TEMPERATURE STRESS

COLD STRESS REDUCTION

The following engineering controls are recommended for reduction of cold stress:

- Use general or spot heating to increase temperature at work site if this does not create a hazardous situation.
- Shield work area from wind.
- Cover metal handles of tools and equipment with thermal insulating materials.
- Do not sit on unprotected metal chair seats.
- Use heated rest areas if work is to be performed in an equivalent chill temperature of 20°F or below.

The following work practice controls are recommended to reduce cold stress:

- Develop and adhere to a work-rest schedule, using the guidelines at the end of this section.
- Drink warm, caffeine-free, sweet, non-alcoholic drinks or soup frequently.
- Schedule work for warmest part of the day.
- Use heated rest areas regularly.
- Use the buddy system. Do not work alone. Observe your co-workers for signs and symptoms of cold stress.

- Allow and encourage workers to pace themselves and take extra breaks when needed. The work schedule should be set by the person most susceptible to cold stress. Do not pressure someone to work beyond their capabilities.
- Whenever possible, allow new workers time to adjust to working in a cold environment before working full time. Ideally, acclimation should occur over five days: 20% Day 1 with a 20% increase on each successive day.
- When possible, arrange the work to minimize standing or sitting still for long periods of time.
- Reorganize work procedures so as much of a job as possible can be done in a warm environment.
- Avoid overtime.
- Remove outer layer of clothing when entering warm shelter.
- If clothes are wet, change to dry work clothes before returning to work in cold. If not possible, loosen clothing to facilitate evaporation of sweat.

SIGNS AND SYMPTOMS OF COLD STRESS

Send a worker to warm shelter immediately if any of the following symptoms are noted:

- Heavy shivering
- Frostnip (skin turns white)
- Feeling of excessive fatigue
- Drowsiness
- Euphoria

FIRST AID

Take victim to a warm area. Remove the outer layers of clothing. Gently warm the affected area, submerge it in tepid water if possible but do not rub. If there is evidence of frostbite, obtain medical attention immediately.

TABLE 1
COLD STRESS WORK/WARM-UP SCHEDULE

Air Temperature with Sunny Sky (degrees F)	Work/Break Schedule (minutes)				
	no wind	5 MPH wind	10 MPH wind	15 MPH wind	20 MPH wind
-05 to -09	110/10	110/10	75/10	55/10	40/10
-10 to -14	110/10	75/10	55/10	40/10	30/10
-15 to -19	75/10	55/10	40/10	30/10	cease
-20 to -24	55/10	40/10	30/10	cease	cease
-25 to -29	40/10	30/10	cease	cease	cease
-30 to -34	30/10	cease	cease	cease	cease
-35 & below	cease	cease	cease	cease	cease

NOTE These recommendations and guidelines are adapted from Threshold Limit Values and Biological Exposure Indices for 1990-1991, published by the American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

NOTE 05 MPH wind - light flag moves, 10 MPH wind - light flag fully extended, 15 MPH wind - raises newspaper sheet, 20 MPH wind - blowing and drifting snow

Table 1 addresses the health hazards related to cold weather work. The practicality of working under a work-rest schedule, together with the ability of the necessary equipment to function properly in cold weather, may be more restrictive than the health hazards and also need to be considered.

Cold stress schedule applies to light or sedentary work activities. Light to moderate work activities can be moved up one level, moderate to heavy work activities can be moved up two levels if workers are acclimated, have proper protective clothing and show no signs of cold stress. For example:

You are shoveling material (which is generally considered heavy work) on a sunny day with a 5 MPH wind. The temperature is -20 degrees F. You could use a 110 minutes work/10 minutes warm-up schedule if you were acclimated to cold weather work.

A 75 minutes work/10 minutes warm-up could be used if you were not acclimated to cold weather work.

TABLE 2
ACTIVITY/METABOLISM RATE ESTIMATES

<u>Work Classification</u>	<u>Activity</u>	<u>Metabolic Rate (kCal/HR)</u>
light	typing	113 to 140
	driving car	140 to 160
moderate	walking with lifting/pulling	250 to 350
heavy	pick/shovel work	380 to 500

HEAT STRESS REDUCTION

While site specific conditions need to be considered, the following guidelines are recommended to prevent or reduce the effects of heat stress.

- Develop and adhere to a work-rest schedule using the guidelines at the end of this section.
- Take breaks in cool areas.
- Drink fluids hourly. The fluids should be caffeine-free and non-alcoholic. Do not wait until you are thirsty. Your normal thirst mechanism is not sufficient to overcome the effects of dehydration. If you feel thirsty, you are already becoming dehydrated.
- Schedule work for the cooler part of the day -- early morning and/or early evening.
- Allow and encourage workers to pace themselves and take extra breaks when needed. The work schedule should be set by the person most susceptible to heat stress. Do not pressure someone to work beyond their capabilities.
- Whenever possible, allow new workers time to adjust to working in a hot environment before working full time. Ideally, acclimation should occur over five days: 20% Day 1 with a 20% increase on each successive day.

- Avoid overtime.
- Use the buddy system. Never work alone and watch your co-workers for signs of heat stress.

PERSONAL MONITORING

At each work break, count your pulse during a 30 second period as early as possible in the rest period.

- If your heart rates exceeds 110 beats per minute (BPM) at beginning of rest period, shorten your next work cycle by 1/3 and keep the rest period the same.
- If your heart rate still exceeds 110 BPM at next rest period, shorten the following work cycle by 1/3.

At the beginning and end of each work shift, measure your weight, ± 0.25 LB, wearing similar clothes. You should not loss more than 1.5 % of your total body weight in a work day. If you do, drink fluids to compensate and to prevent dehydration.

SIGNS AND SYMPTOMS OF HEAT STRESS

Heat rash

Heat cramps

Muscle spasms; pain in hands, feet or abdomen

Heat exhaustion

Pale, cool moist skin; heavy sweating; dizziness; nausea; fainting

Heat stroke

Red, hot, usually dry skin; lack of, or reduced, perspiration; nausea; dizziness; confusion; strong, rapid pulse; coma

FIRST AID

Remove the affected individual's protective clothing and equipment. Douse the victim with water. Wrap the victim in wet towels or clothing. If there are signs or symptoms of heat exhaustion or heat stroke, get medical attention immediately.

TABLE 3
HEAT STRESS MONITORING SCHEDULE (MINUTES)

Adjusted Temperature* <u>(degrees F)</u>	Normal Work <u>Clothes</u>	Impermeable Work <u>Clothes</u>
above 90	45	15
88 to 90	60	30
83 to 87	90	60
77 to 82	120	90
72 to 78	150	120

* Adjusted temperature = measured temperature + (13 x % sunshine)

NOTE These recommendations and guidelines are adapted from Threshold Limit Values and Biological Exposure Indices for 1990-1991, published by the American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

Table 3 applies to moderate work levels. For heavy work levels, apply monitoring schedule one level up. Light to sedentary work activities can be moved down one level if workers are acclimated and show no signs of heat stress. For example:

You are performing oversight work in Level D and your task is to record data. It is 75 degrees F and sunny. The adjusted temperature is then 88 degrees F. If you are acclimated to warm weather work, you could work and conduct heat stress monitoring every 90 minutes. If, on the other hand you were shoveling material and were acclimated to warm weather work, you would need to monitor for heat stress every 45 minutes.

TABLE 4
ACTIVITY/METABOLISM RATE ESTIMATES

<u>Work Classification</u>	<u>Activity</u>	<u>Metabolic Rate (kcal/hr)</u>
light	typing	113 - 140
	driving car	140 - 160
moderate	walking with lifting/pulling	250 - 350
heavy	pick/shovel work	380 - 500

E

GENERAL SITE HEALTH AND
SAFETY RULES

E

GENERAL SITE HEALTH AND SAFETY RULES

No smoking in Warzyn site trailers or vehicles.

No food, beverages or tobacco or cosmetic products are to be used, consumed or brought into the exclusion or decontamination zones or any other potentially contaminated areas so designated by the Site Safety Officer (SSO).

A respirator can not be worn when beards or any other facial hair interferes with the face-to-respirator seal. Individuals with such facial hair are not to be allowed to work in Level of Protection C or B.

Working alone on field sites is generally prohibited. The "buddy system" is to be enforced at all times unless the Health and Safety Coordinator (HSC) specifically exempts the work from this requirement, based on the HSC's review of site conditions and hazards. When working under the "buddy system", personnel are to:

- Never work alone.
- Provide partner with assistance.
- Observe partner for signs of overexposure/temperature stress.
- Check integrity of partner's protective clothing.
- Notify others if emergency help is needed.

Personnel on site must use the buddy system when wearing respiratory protective equipment. Visual contact must be maintained between pairs on-site and safety

personnel. Entry team members are to remain close together to assist each other during emergencies.

Necessary emergency, audio, visual and hand signals are to be determined by the SSO. The SSO is to familiarize all site personnel with these signals and document this meeting.

Field personnel are not to enter confined spaces such as pits, trenches, tanks or manholes, unless confined space entry procedures are specifically included in the Site Safety Plan (SSP) and are fully implemented.

Drums or tanks found on site are not to be opened or moved unless specific drum/tank remediation tasks are specifically included in the SSP and are fully implemented.

Site personnel are to notify the SSO of any unsafe acts or conditions.

Site personnel are to notify the SSO at the first indication that they are experiencing temperature stress or any signs or symptoms which may be due to exposure to chemicals.

Any excavations are to be filled in or barricaded at the end of the work day.

Any scrap, waste, debris or other materials generated by site activities are to be properly contained and labeled.

Site personnel are expected to comply with applicable OSHA, EPA or other regulatory agency standards and regulations at all times.

F

DECONTAMINATION

F

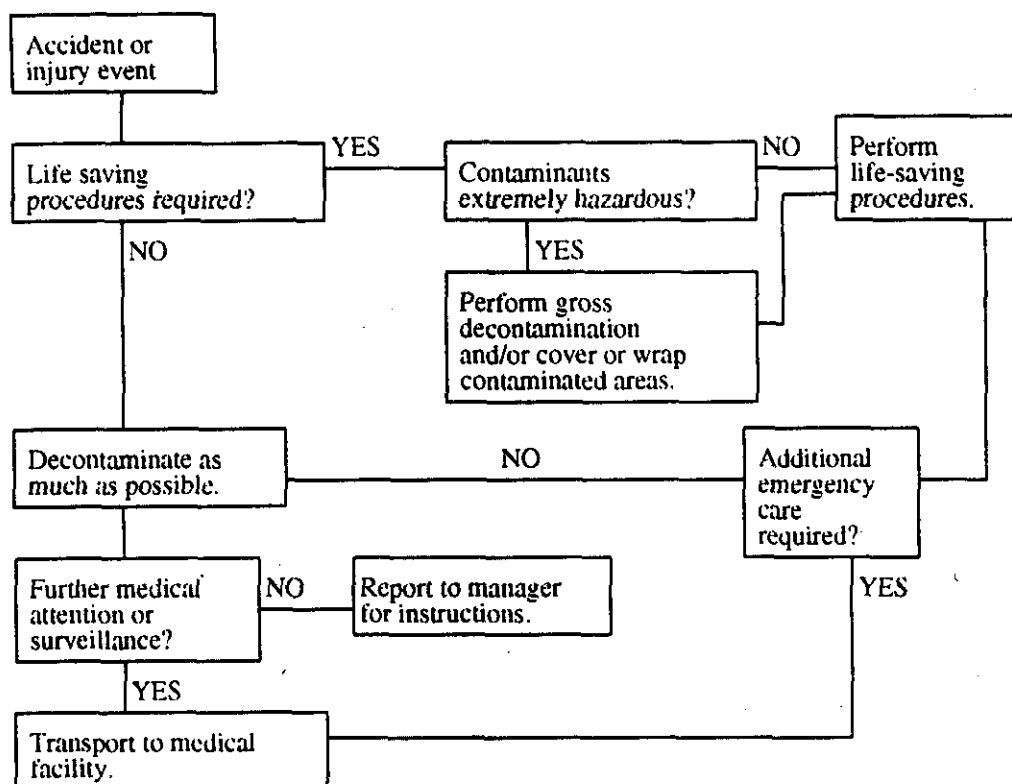
DECONTAMINATION

EMERGENCY DECONTAMINATION

The need for emergency decontamination of an individual may arise as the result of:

- Injury or illness
- Overexposure to chemicals or hazardous substances
- Temperature stress

Primary consideration needs to be given to life-preservation actions and the minimization of additional harm or health risks to the individual in the emergency situation and the rescuing individuals.



LEVEL B ROUTINE DECONTAMINATION

Equipment Drop

Deposit equipment used on site (tools, sampling devices, monitoring equipment, radios, etc.) on plastic drop cloths. Decontaminate or dispose of items before removal from exclusion zone.

Outer Boot/Glove Wash and Rinse

Scrub outer boots/gloves with decontamination solution (Liquinox or another non-phosphate detergent solution and deionized water) then rinse with water.

Outer Boot/Glove Removal

Remove outer boots/gloves:

- If outer boots/gloves are disposable, deposit them in the appropriate plastic-lined container.
- If outer boots/gloves are not disposable, store them in a clean, dry place.

Outer Garment Removal

If using self-contained breathing apparatus (SCBA), remove SCBA back pack and remain on air as long as possible. Remove chemical-protective outer garments and deposit in the appropriate container.

Respiratory Protection Removal

Remove hard hat and face piece, and deposit on a clean surface. Wash and rinse hard hat and face piece. Wipe off and store face piece in a clean, dry location.

Inner Glove Removal

Remove inner gloves and deposit in the appropriate container for disposal.

Field Wash

Thoroughly wash hands and face with soap and water. Shower as soon as possible.

LEVEL B DECONTAMINATION FOR AIR TANK EXCHANGE**Equipment Drop**

Deposit equipment used on site (tools, sampling devices, monitoring equipment, radios, etc.) on plastic drop cloths. Decontaminate or dispose of items before removal from exclusion zone.

Outer Boot/Glove Wash and Rinse

Scrub outer boots/gloves with decontamination solution then rinse using water.

Outer Boot/Glove Removal

Remove outer boots/gloves:

- If outer boots/gloves are disposable, deposit them in the appropriate plastic-lined container.
- If outer boots/gloves not disposable, store them in a clean, dry place.

Tank Change

Exchange air tank. Don new outer boots/gloves. Tape joints and return to exclusion zone.

LEVEL C ROUTINE DECONTAMINATION

Equipment Drop

Deposit equipment used on site (tools, sampling devices, monitoring equipment, radios, etc.) on plastic drop cloths. Decontaminate or dispose of items before removal from exclusion zone.

Outer Boot/Glove Wash and Rinse

Scrub outer boots/gloves and/or splash suit with decontamination solution then rinse with water.

Outer Boot/Glove Removal

Remove outer boots/gloves:

- If outer boots/gloves are disposable, deposit in them in the appropriate plastic-lined container.
- If outer boots/gloves are not disposable, store them in a clean, dry place.

Outer Garment Removal

Remove chemical-protective outer garments and deposit them in the appropriate container.

Respiratory Protection Removal

Remove hard hat and respirator and deposit them on a clean surface. Discard respirator cartridges in the appropriate container. Wash and rinse hard hat and respirator. Wipe off and store respirator in a clean, dry location.

Inner Glove Removal

Remove inner gloves and deposit in them in the appropriate container for disposal.

Field Wash

Thoroughly wash hands and face with soap and water. Shower as soon as possible.

LEVEL C DECONTAMINATION FOR RESPIRATOR-CARTRIDGE EXCHANGE

Equipment Drop

Deposit equipment used on site (tools, sampling devices, monitoring equipment, radios, etc.) on plastic drop cloths. Decontaminate or dispose of items before removal from exclusion zone.

Outer Boot/Glove Wash and Rinse

Scrub outer boots/gloves and/or splash suit with decontamination solution then rinse with water.

Outer Boot/Glove Removal

Remove outer boots/gloves:

- If outer boots/gloves are disposable, deposit them in the appropriate plastic-lined container.
- If outer boots/gloves are not disposable, store them in a clean, dry place.

Respirator Cartridge Change

Exchange respirator cartridges. Don new outer boots/gloves. Tape joints and return to exclusion zone.

LEVEL D-MODIFIED ROUTINE DECONTAMINATION**Equipment Drop**

Deposit equipment used on site (tools, sampling devices, monitoring equipment, radios, etc.) on plastic drop cloths. Decontaminate or dispose of items before removal from exclusion zone.

Outer Boot/Glove Wash and Rinse

(Optional, include if necessary for gross decontamination)

Scrub outer boots/gloves and/or splash suit with decontamination solution then rinse with water.

Outer Boot/Glove Removal

Remove outer boots/gloves:

- If outer boots/gloves are disposable, deposit them in the appropriate plastic-lined container.
- If outer boots/gloves are not disposable, store them in a clean, dry place.

Outer Garment Removal

Remove chemical protective outer garments and deposit them in an appropriate container. Remove hard hat and safety glasses. Decontaminate them as necessary and deposit on a clean surface.

Inner Glove Removal

Remove inner gloves and deposit them in the appropriate container for disposal.

Field Wash

Thoroughly wash hands and face with soap and water. Shower as soon as possible.

G

EMERGENCY RESPONSE

G

EMERGENCY RESPONSE

Based on the type of potential hazards that may be present, the Site Safety Officer (SSO) is to determine if a site specific emergency response plan is necessary prior to the beginning of work. If a site specific plan is necessary, it is to be attached to the Site Safety Plan (SSP).

FIRES AND EXPLOSIONS

Even a minor fire can become a serious problem, particularly when adjacent to flammable or combustible materials. The first few minutes after discovery of a fire are the most critical in preventing a larger emergency.

In case of a fire or explosion, immediately turn off burners and other heating devices and stop any work in progress. Give priority to assisting injured persons.

Small Fires

Take the following actions immediately:

- Alert other personnel in the vicinity and send someone for assistance
- If it is a small fire - one that can be extinguished within 30 seconds or with one fire extinguisher - attempt to extinguish the blaze if:
 - Conditions are safe
 - You have the proper type of fire extinguisher
 - You have been trained to use a fire extinguisher properly
 - You are not alone

The combination (ABC) extinguishers in the Warzyn Emergency Kits can be used against the following classes of fires:

- Class A fires - ordinary combustible solids such as paper, wood, coal, rubber and textiles
- Class B fires - petroleum hydrocarbons (diesel fuel, motor oil and grease) and volatile flammable solvents
- Class C fires - electrical equipment

These extinguishers, however, are not effective against Class D fires which include combustible or reactive metals (such as sodium and potassium), metal hydrides or organometallics. Special Class D extinguishers are required.

Avoid entrapment by a fire; always fight from a position accessible to an exit.

If there is any chance that the fire can not be controlled by locally available personnel and equipment, the following action should then be taken:

- Activate the emergency alarm system (if available) and notify the local fire department.
- Confine the emergency to prevent further spread of the fire.
- Assist injured personnel and provide first aid or transportation to medical aid, if necessary.

Next notify client if the client is in close proximity to the fire. (If not, notify the fire department). Assess the need with the client to contact the fire department. If the fire department is contacted, be prepared to tell them:

- Who you are
- Your location
- Type of fire (i.e., electrical, chemical, combustible solids, vapor)
- If the fire is extinguished
- The need for medical assistance

- Other potential hazards in the area (i.e., proximity to bulk tanks, downed electrical lines, poor access)
- What you will be doing after you hand up the phone and where they can find you or reach you

Upon arrival of the local fire department, brief them of the incident. When given permission, contact the Project Manager (PM) or in the PM's absence, the office Health and Safety Coordinator or Corporate Health and Safety Manager.

Large Fire or Explosion

If other people are in the area, immediately notify them and then call the local fire department. Be prepared to tell them:

- Who you are
- Your location
- Type of fire (i.e., electrical, chemical, combustible solids, vapor)
- If the fire is extinguished
- The need for medical assistance
- Other potential hazards in the area (i.e., proximity to bulk tanks, downed electrical lines, poor access)
- What you will be doing after you hand up the phone and where they can find you or reach you

Upon arrival of the fire department, turn over command to them and supply as much information as possible. When given permission, contact the PM or in the PM's absence, the office Health and Safety Coordinator or Corporate Health and Safety Manager. Get a number where they can again be reached.

FLAMMABLE/COMBUSTIBLE LIQUID SPILLS

If a spill of a flammable or combustible liquid occurs, all possible sources of ignition will be extinguished or removed immediately.

Use Material Safety Data Sheets (MSDSs), analytical information from laboratory personnel, and any other available sources of information, together with your own

expertise to determine if spill control and clean up can be safely accomplished with the personnel and materials on site.

The following general spill clean up procedures can be utilized, but more specific techniques might be required for certain chemicals.

- Vermiculite or other suitable absorbent may be used to solidify free liquids.
- Both spilled liquids and solids residues must be contained in drums.
- If a spill occurs on soil, it must be scraped and contained.

EVACUATION

Prior to beginning work, the SSO should brief all Warzyn and subcontractor employees on what the evacuation signal should be. It may be nothing more than a verbal command or it may be some audible alarm such as a bell or horn. If working at a client's site, familiarize yourself with their warning system.

Prior to work, the SSO should determine a meeting place if evacuation is necessary. Preferable the meeting place should be upwind of the work activities and at a safe distance. All Warzyn and subcontractor employees should be informed of the meeting location.

If evacuation is necessary, everyone should go directly to the meeting area. The SSO should ensure all personnel (Warzyn and subcontractor) are accounted for. This will mean checking the sign-off documentation on the Site Health & Safety Plan or on larger jobs the daily sign-in roster. The local on-scene commander should immediately be notified of any missing personnel as well as their last known whereabouts.

Site Evacuation

If an evacuation of the site is necessary, certain rules must be strictly followed:

- Employees in the vicinity should immediately shut down all equipment and disconnect electrical or flammable power sources to machinery.
- Immediately after personnel are alerted, they will evacuate the facility via the nearest escape route.
- All evacuated personnel will assemble at the predetermined meeting place.

- Employees should not wait for friends; the Site Safety Officer will ensure all personnel have evacuated before departing.
- Employees should move quickly and calmly without panic.
- Employees should not smoke.
- Once assembled, employees should remain calm and quiet while the Site Safety Officer takes roll call and assess the situation. Each employee must report to the Site Safety Officer until everyone is accounted for and evacuation is complete.

Off-Site Evacuation

If an incident is large enough, off-site personnel may also need evacuation. If off-site evacuation is necessary, follow the appropriate local notification procedures, generally through the fire department. Warzyn personnel should not attempt to evacuate off-site personnel but should leave that task to the local authorities. All Warzyn employees should follow the evacuation directions given by the local authorities. The site Safety Officer should offer to remain at the command post to supply information. If told to leave, the SSO should leave.

Local authorities will have present and on-scene commander. The on-scene commander will direct emergency operations and will have assistance from the local fire department, police department and emergency government.

After evacuating to a safe area, the PM should be contacted or in the the PM's absence, the office Health and Safety Coordinator or Corporate Health and Safety Manager.

DISCUSSION OF INCIDENT

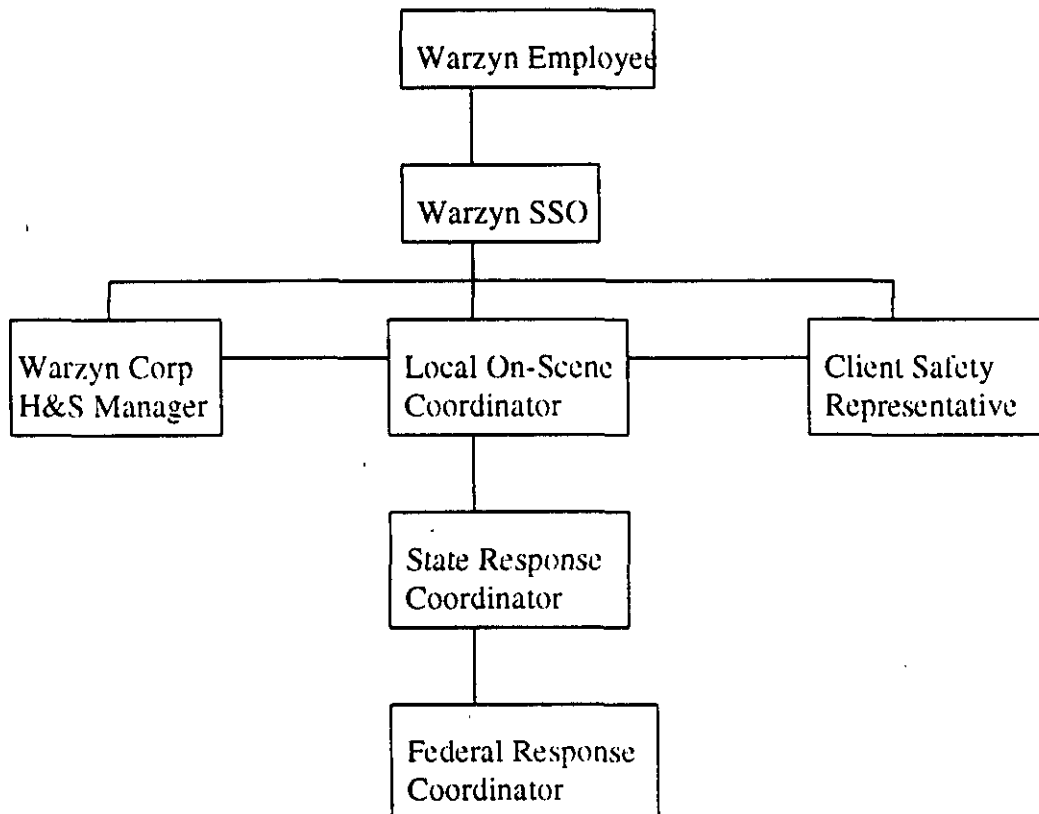
At no time should a Warzyn employee discuss an emergency incident with members of the media. Politely refuse to discuss the situation and instead, direct all inquiries to the Corporate Health and Safety Manager. Provide the media people with the office phone number.

However, Warzyn employees should always provide whatever useful information they can to response personnel. Stick to helpful facts and avoid placing blame or judgement. That will be sorted out later. Politely refuse to find fault or place blame.

At a safe place and at the appropriate time, write down all you remember of the incident. How did it happen? Who was doing what? What did I see? What did I hear? All these types of things may be important later when things are sorted out.

CHAIN-OF-COMMAND

The number of people involved in an incident will be directly related to the severity of the incident. In the event of an incident, the chain-of-command could be as extensive as:



Upon arrival of the local on-scene coordinator or client safety representative, the Warzyn SSO should turn over command of the situation. The responsibility of the Warzyn SSO is then to supply information and offer Warzyn supplies and personnel if requested. It is likely the local on-scene coordinator or client safety representative will not request Warzyn personnel but may request Warzyn supplies (HNU, absorbent drums). In a major incident, it is likely the Warzyn Health and Safety Manager will arrive at the scene. At that time, all

responsibilities of the SSO should be turned over to the Health and Safety Manager.

H

FIRST AID

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FIRST AID

GENERAL SEQUENCE FOR TREATMENT OF EXPOSURES TO UNKNOWN CHEMICALS

Quickly protect yourself from exposure before attempting to rescue the victim.

Decontaminate the victim and terminate exposure.

Treat cessation of breathing first.

If the heart is not beating, perform cardiopulmonary resuscitation (CPR).

Treat eye injuries next.

Treat skin contact.

Treat shock.

Call for help.

PRELIMINARY ASSESSMENT

Make a quick assessment of the likely routes of exposure by examining the eyes, mouth, nose and skin of the victim for signs of the chemical itself or damage it has caused such as swelling, redness, bleeding, burns, discharge of fluid or mucous or pallor.

Drooling, difficult swallowing, a distended and painful or hard, rigid abdomen all indicate possible ingestion of a corrosive or caustic substance.

If respirations are rapid, shallow, noisy or labored, suspect inhalation.

If the face has been splashed with chemical, eye contact is likely.

POISONING BY INHALATION

Remove the victim from exposure while protecting yourself from exposure.

If breathing has stopped, administer artificial resuscitation using a disposable resuscitator and avoid mouth-to-mouth contact. **DO NOT** use mouth-to-mouth resuscitation if the nature of the chemical exposure is unknown.

Maintain an open airway.

Notify an emergency medical service of the nature of the accident and arrange for transport to a medical facility.

POISONING BY INGESTION

Remove the victim from exposure while protecting yourself from exposure.

Call a poison control center, emergency room or physician for advice.

Notify an emergency medical service of the nature of the accident and arrange for transport to a medical facility.

Consult the MSDS to determine whether to offer victim water to drink or to induce vomiting and by what means.

If the victim is conscious:

- Have the victim rinse out mouth with water.
- And there are no signs of burns, swallowing difficulty or abdominal problems and victim is conscious and if so advised by a physician or poison control center:
 - Induce vomiting by giving two teaspoons of Syrup of Ipecac. Follow with at least one cup of water. **DO NOT** use milk. If you do not have Syrup of Ipecac, induce vomiting by asking the victim to touch the back of the throat with a finger, spoon handle or blunt instrument.

- Have the victim sit up or lean forward while vomiting.
- Save any vomitus and give it to the emergency medical service personnel to take to the medical facility for analysis.
- Give the victim one to two cups of water to drink after vomiting has ceased.
- Keep talking to the victim to prevent sleepiness.

If the victim is unconscious:

- Lay the victim on the victim's left side, bending the victim's right hip
- Maintain an open airway
- Arrange for transport to the nearest medical facility
- Stand by to administer artificial resuscitation and CPR if needed. Be sure to wipe or rinse all traces of chemical from in and around the victim's mouth before giving artificial resuscitation. **DO NOT** use mouth-to-mouth resuscitation if the nature of the chemical exposure is unknown. If breathing has stopped, administer artificial resuscitation using a disposable resuscitator and avoid mouth-to-mouth contact.

If the victim vomits, save the vomitus and send it to the medical facility for analysis.

If the victim shows signs of shock (a weak, rapid pulse; pale clammy skin; cold hands and feet), elevate the victim's feet eight to twelve inches and cover the victim with a blanket.

DO NOT give an unconscious person anything to drink.

DO NOT give someone who is convulsing anything to drink.

POISONING BY SKIN CONTACT

Remove the victim from the contaminated area, being careful to protect your lungs, skin and eyes.

Remove the victim's clothing, shoes and jewelry from the affected areas, cutting them off if necessary. Do this under a shower or while flushing with water.

Continue to flush with water until all trace of the chemical is gone and any slippery feeling has disappeared also. Rinse for at least 15 minutes.

Cover the victim with a blanket or dry clothing.

Notify a physician, emergency room or poison control center of the accident and obtain advice.

In case of inflammation, burns, blisters or pain:

- Loosely apply a dry sterile dressing, if available, or use a clean dry cloth.
- Notify an emergency medical service of the nature of the accident and arrange for transport to a medical facility.
- If the victim is in a state of shock:
 - Lay the victim down on the victim's side and cover the victim with a blanket.
 - Elevate the victim's feet eight to twelve inches.
 - Notify an emergency medical service of the nature of the accident and arrange for transport to a medical facility.

DO NOT break open blisters or remove skin. If clothing is stuck to the skin after flushing with water, do not remove it.

DO NOT rub or apply pressure to the affected area.

DO NOT apply any oily substance to the affected skin.

DO NOT use hot water.

POISONING BY EYE CONTACT

Remove the victim from the contaminated area, being careful to protect your lungs, skin and eyes.

Act quickly. Seconds count. Flush the victim's eye(s) with clean tepid water for at least 15 minutes. Have the victim lie or sit down and tilt head back. Hold eyelid(s) open and pour water slowly over the eyeball(s) starting at the inner corners by the nose and letting the water run out of the outer corners. The victim may be in great pain and want to keep eyes closed or rub them but you must rinse the chemical out of the eye(s) in order to prevent possible permanent damage.

Ask the victim to look up, down and side to side as you rinse.

Call an emergency medical service and arrange for transport to the nearest facility for examination and treatment as soon as possible. Even if there is no pain and vision is good, a physician should examine the eye(s) since delayed damage may occur.

If the eye(s) is(are) painful:

- Cover loosely with gauze or a clean, dry cloth
- Maintain verbal and physical contact with the victim

I

ACTION LEVELS

I

ACTION LEVELS

These are guidelines for setting action levels and while they are generally valid, specific site conditions must be evaluated to determine if any alterations to the SOP are indicated.

ORGANIC VAPORS

Action levels are based on direct instrument readings made in the breathing zone from organic vapor detectors such as a photoionization detector (PID) or flame ionization detector (PID). These are relative, not absolute readings.

TABLE 1
Standard Organic Vapor Action Levels
Based on Direct Reading Instruments

<u>Instrument Reading</u>	<u>Level of Protection</u>
≤background	Level D
<5 units above background	Level C
5-50 units above background	Level B
≥50 units above background	Cease operations and move to safe area. Confer with the Site Safety Officer (SSO). Re-evaluate work plan.

COMBUSTIBLE GASES

Action levels are based on the readings of a combustible gas meter. The readings are generally given as a percentage of the lower explosion limit (% LEL). An atmospheric oxygen level of less than 19.5% may affect the readings of a combustible gas meter and give lower than actual levels.

TABLE 2
Standard Combustible Gas Action Levels
Based on Direct Reading Instruments

<u>Instrument Reading</u>	<u>Action to be Taken</u>
0 to 10% LEL	Continue working and monitoring atmosphere for combustible gases. Inform personnel working in area whenever readings >5% LEL.
10 to 20% LEL	Continue working with caution. Inform personnel working in area of readings. Be prepared to cease operations.
>20% LEL	Cease operations and move to safe area. Re-evaluate work plan. Engineering controls such as forced ventilation and use of non-sparking tools are to be implemented if operations are to continue. DO NOT CONTINUE WORKING UNTIL CONDITIONS ARE CONSISTENTLY BELOW 20% LEL.

For field work being conducted at a municipal landfill site, the following action levels can be used for combustible gas readings taken at or near the borehole.

TABLE 3
Combustible Gas Action Levels
for Municipal Landfills
Based on Direct Reading Instruments

<u>Instrument Reading</u>	<u>Action to be Taken</u>
<20% LEL	Continue working and monitoring atmosphere for combustible gases. Inform personnel working in area whenever readings >10% LEL.
20 to 40% LEL	Continue working with caution. Inform personnel working in area of readings. Be prepared to cease operations.
>40% LEL	Cease operations and move to safe area. Re-evaluate work plan. Engineering controls such as forced ventilation and use of non-sparking tools are to be implemented if operations are to continue. DO NOT CONTINUE WORKING UNTIL CONDITIONS ARE CONSISTENTLY BELOW 40% LEL.

NOTE When oxygen levels are above 23.5% or below 19.5%, combustible gas meter readings are not reliable as there is insufficient oxygen for complete combustion.

OXYGEN

A direct reading oxygen meter is used to determine the percent of oxygen in the atmosphere.

TABLE 4
Percentage Oxygen Action Levels
Based on Direct Reading Instruments

<u>Instrument Reading</u>	<u>Action to be Taken</u>
<19.5% or >23.5%	Cease operations and move to safe area. Re-evaluate work plan. Engineering controls such as forced ventilation and use of non-sparking tools are to be implemented if operations are to continue. DO NOT CONTINUE WORKING UNTIL OXYGEN LEVELS ARE BETWEEN 19.5 AND 23.5%. When oxygen levels are outside this range, combustible gas meter readings are not reliable.

HYDROGEN CYANIDE (HCN)

Whenever the any positive reading is noted on the direct reading HCN meter, cease work immediately and contact the Site Safety Officer (SSO) or Health and Safety Coordinator (HSC). The ceiling for HCN is 10 PPM, and the alarm is set for 10 PPM.

If approval is given by the SSO or HSC, verification of the presence of HCN is to be made using colorimetric tubes which can detect HCN. The person taking the sample is to wear appropriate respiratory protection. There is no air-purifying cartridge approved for use in a atmosphere containing HCN, a supplied-air respirator must be used.

If the presence of HCN is confirmed, cease activities and contact the HSC. If the colorimetric tubes do not indicate the presence of HCN, continue with site activities cautiously and continue to monitor for HCN with the direct reading meter.

HYDROGEN SULFIDE (H₂S)

Whenever the alarm sounds on the direct reading H₂S meter, cease work immediately and contact the SSO or HSC. For H₂S the TLV level is 10 PPM, and the alarm is set for 10 PPM.

If approval is given by the SSO or HSC, verification of the presence of H_2S is to be made using colorimetric tubes which can detect H_2S . The person taking the sample is to wear appropriate respiratory protection. There is no air-purifying cartridge approved for use in a atmosphere containing H_2S , a supplied-air respirator must be used.

If the presence of H_2S is confirmed, cease activities and contact the HSC. If the colorimetric tubes do not indicate the presence of H_2S , continue with site activities cautiously and continue to monitor for H_2S with the direct reading meter.

CARBON MONOXIDE (CO)

Whenever a detection is made with the direct reading CO meter in excess of 50 PPM, cease work immediately and contact the SSO or HSC.

If approval is given by the SSO or HSC, verification of the presence of CO is to be made using colorimetric tubes which can detect CO. The person taking the sample is to wear appropriate respiratory protection. There is no air-purifying cartridge approved for use in a atmosphere containing CO, a supplied-air respirator must be used.

If the presence of CO is confirmed, cease activities and contact the HSC. If the colorimetric tubes do not indicate the presence of CO, continue with site activities cautiously and continue to monitor for CO with the direct reading meter.

VINYL CHLORIDE

Whenever any reading above background is noted with the organic vapor monitor, colorimetric tubes will be used to verify the presence of vinyl chloride. If vinyl chloride is found to be present above 1 ppm, personnel will cease operations and contact the Health and Safety Manager for authorization to upgrade to Level B protection.

NOTE: There is no air-purifying cartridge approved for use in an atmosphere containing vinyl chloride. A supplied-air respirator must be used.

[CHI 651 96c]

J

CONFINED SPACE ENTRY

J

CONFINED SPACE

DEFINITION OF CONFINED SPACE

A confined space is defined as an enclosed space which meets all of the criteria below:

- Is large enough that a person can enter it and perform assigned work
- Has a limited means for exit or entry such as a tank, vessel, silo, storage bin, hopper, vault, pit, trench, or diked area
- Is not designed for continuous human occupancy
- Meets any of the following criteria:
 - Contains or has a known potential to contain a hazardous atmosphere
 - Contains a material with the potential for engulfment of an entrant
 - Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or a floor which slopes downward and tapers to a small cross-section
 - Contains any other recognized serious safety or health hazard

If you can not enter and exit an enclosed space by walking into and out of it in an upright manner, it has a limited means of exit/entry and may be a confined space. Open-top spaces which require the use of ladders, hoists or other devices for exit may be confined spaces.

Spaces designed to store product, enclose materials and processes, or transport products or substances can be confined spaces. They are generally not designed for persons to enter and work in them on a routine basis though they may have limited access for occasional worker entry for inspection, maintenance, repair, cleanup, etc.

A trench is defined as a narrow excavation made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench, measured at the bottom, is not greater than 15 feet.

An excavation less than five feet deep with no potential for cave-in does not need the protection requirements (sloping, shoring, etc.) required by OSHA in its Excavation Regulations, but it might still be considered a confined space. OSHA requires air monitoring for entry into excavations over 4 ft deep if there is a potential for encountering hazardous atmospheres. If excavations are less than 4 ft deep and personnel are kneeling or performing work requiring them to bend over, air monitoring is still required because their heads are below the ground surface and gases heavier than air may accumulate in these areas.

CLASSES OF CONFINED SPACES

To help employers prevent confined space entry deaths, the National Institute for Occupational Safety and Health (NIOSH) has determined three classes of confined spaces based upon life-threatening characteristics.

Class A

This space is immediately dangerous to life or health (IDLH) and consists of one or more of the following conditions:

- Oxygen is less than 16% or more than 25% by volume
- Atmosphere flammability is greater than 20% of the lower explosion limit (LEL)
- Toxicity is IDLH

Class B

This space, while not immediately life threatening, does pose considerable danger. Conditions which result in a Class B space can be caused by any of the following:

- Oxygen levels between 16.1% and 19.4% or 21.5% to 25%
- Flammability levels at 10% to 19% LEL

- Toxicity greater than the Threshold Limit Value (TLV) but less than IDLH

Class C

Class C spaces reflect a potential hazard. None of the following conditions can be exceeded in a Class C space. If any condition is not met, the space can not be Class C:

- Oxygen between 19.5% and 21.5%
- Flammability less than 9% LEL
- Toxicity less than TLV

GENERAL REQUIREMENTS FOR CONFINED SPACE ENTRY

NIOSH has also recommends that the following procedures be followed for entry into confined spaces.

Class A

At least two rescue workers should be fully equipped with Self-Contained Breathing Apparatus (SCBA). Communication should be established with an additional person within the confined space.

Class B

Rescue procedures require only one person fully equipped with life support equipment. Indirect visual or auditory communication with workers is recommended.

Class C

Standard work and rescue procedures are appropriate. Direct communication with workers from outside the confined space is necessary.

CONFINED SPACE ENTRY LIMITATIONS

The SSO is to allow entry into confined only if all of the following criteria are met:

- The Site Safety Plan addressed confined space entry under the scope of site activities.
- The Health and Safety Manager has reviewed and signed the Site Safety Plan.

- No other non-entry procedure can be used to complete the necessary work.
- There is no danger of engulfment.
- The atmosphere can not become IDLH.
- At least one of the following items is in place:
 - The space has been ventilated using a mechanically powered ventilator for a period of time not less than that specified in the ventilation nomograph for that ventilator and that the ventilation continues throughout the entry.
 - A combination of appropriate atmospheric testing and mechanically powered ventilation is used.
 - Appropriate continuous atmospheric testing assures that permit conditions are maintained.

Non-attendant confined space entries are not permitted.

TRAINING

The following outlines the minimum topics that must be covered in annual confined space entry training for the types of individuals noted.

All Employees Who May Be Required to Enter Confined Spaces in the Course of Their Employment

- Procedures and control for entry
- Emergency action plan
- Hazard recognition
- Nature of hazards
- Testing to be performed to determine if it is safe to enter
- Toxic effects and symptoms of exposure to anticipated hazardous materials via absorption, inhalation and/or ingestion

- Use of personal protective equipment including respirators and clothing, required for entry or rescue and barriers or protective shields
- Self-rescue
- Evacuation requirements
- Modifications of normal work practices that are necessary for confined space work

Persons Authorizing/In Charge of Entry, Site Safety Officers

- All of the requirements noted for employees who may be exposed to permit entry of confined spaces in the course of their employment
- Recognition of the effects of exposure to hazards reasonably expected to be present
- Duties outlined in this section

Attendants

- Emergency action plan
- Proper use of communications equipment furnished to communicate with entrants or summon emergency/rescue services
- Authorized procedures for summoning emergency/rescue services
- *Recognition of early behavioral signs of intoxication caused by contaminants whose presence could be anticipated in the space*
- Duties outlined in this section

INDIVIDUAL RESPONSIBILITIES

Health and Safety Manager

Provide annual training as outlined in this section. Review all Site Safety Plans requiring confined space entry.

Site Safety Officers

Review Site Safety Plan to confirm that the identity of each confined space on site has been noted.

Use the NIOSH guidelines for classifying confined spaces as an aid in determining the appropriate procedures.

Allow entry into confined spaces only if all of the following criteria are met.

- Confined space is not classified as NIOSH Class A.
- No other non-entry procedure can be used to complete the necessary work.
- There is no danger of engulfment.
- The atmosphere can not become IDLH.
- At least one of the following items is in place:
 - The space has been ventilated using a mechanically powered ventilator for a period of time not less than that specified in the ventilation nomograph for that ventilator and that the ventilation continues throughout the entry.
 - A combination of appropriate atmospheric testing and mechanically powered ventilation is used.
 - Appropriate continuous atmospheric testing assures that permit conditions are maintained.

Do not permit non-attendant confined space entries.

Prior to the start of site activities:

- Inform site workers of the location of each confined space to prevent inadvertent entry.
- Assure the availability and use of all personal protective equipment and clothing necessary for safe entry.
- Assure that rescue and safety related equipment, such as lifting or retrieval devices, are readily available prior to entry. Provide for and require the

use of retrieval lines, or equivalent equipment, to make non-entry rescues possible.

Provide appropriate vehicle and pedestrian guards, barriers, or other means to protect the entry party and attendants from local traffic hazards and to protect non-entering employees from hazards arising from the confined space.

Do not authorize or allow employees who have not been trained in permit entry of confined spaces to enter any confined space.

All personnel entering confined spaces must wear a safety harness with a life-line.

Determine actual and potential hazards associated with the space at the time of entry. Choose the appropriate means to execute a safe entry.

Assure all necessary control measures are completed:

- Isolation (i.e., lock-out, blanking, disconnections, etc.)
- Space preparation (i.e., cleaning, purging, inert atmosphere in place, etc.)

Assure, by appropriate testing, that the control measures used are effective. Assure proper calibration of test and/or monitoring equipment.

Determine and evaluate the source (e.g., residue to be removed from space, leaking valve or pipe in space) of any atmospheric contamination found at the time of entry.

Provide an attendant for each permit entry of a confined space.

Complete the "Confined Space Entry Isolation/Preparation Checklist". Identify by job title or name those persons who must sign the entry permit and the duties of each, including the person in charge of entry.

Specify the duration the permit is good for on the Confined Space Entry Permit and include conditions requiring the preparation of a new permit.

Persons Authorizing/In Charge of Entry

Verify that the necessary pre-entry conditions exist. Record conditions and measured atmospheric gas levels on "Confined Space Entry Permit".

Verify that an on-site rescue team is available if it is to be used. Record on "Confined Space Entry Isolation/Preparation Checklist".

Verify that the means for summoning the on-site rescue team or other emergency assistance is operable. Record on "Confined Space Entry Isolation/Preparation Checklist".

Complete all portions of "Confined Space Entry Permit". Assure that pre-entry and authorizing signatures portions of the permit are completed before any employee enters a confined space.

Terminate the entry upon becoming aware of a non-permitted condition.

May serve as attendant.

Attendant

Remain outside the confined space. Under no circumstances is the attendant to enter the confined space, even in an emergency, until help arrives. Do not leave for any reason while entry continues, except for self-preservation, unless replaced by a qualified individual.

Maintain continuous communication with all authorized entrants within the confined space by voice, radio, telephone, visual observation or other equally effective means.

Order entrants to exit the space at the first indication of a non-permitted condition, unexpected hazard, indication of a toxic reaction, unusual conduct of entrants, external situation that could pose a hazard to the entrants.

Know the procedure and have the means to summon immediate emergency assistance.

Do not allow anyone to enter the confined space to affect a rescue unless that person is wearing appropriate PPE, including a safety harness with lifeline and the necessary respiratory protection.

Warn unauthorized persons not to enter, or to exit immediately if they have entered.

Assist in handling tools and materials, relaying messages, prevent fouling of air hoses and lifelines in use.

[CHI 651 96b]

**CONFINED SPACE ENTRY
ISOLATION/PREPARATION CHECKLIST**

CONTINUOUS MONITORING REQUIRED

Oxygen?	Yes	No	Flammability?	Yes	No
Others?	Yes	No	Specify: _____		
Zero-energy state exists within space?				Yes	No
All electrical circuits are locked out and discharged?				Yes	None present
All pneumatic circuits are locked-out and discharged?				Yes	None present
All hydraulic circuits are locked out and discharged?				Yes	None present
All steam lines locked out and discharged?				Yes	None present
All inlet lines are disconnected or blanked-off?				Yes	None present
Space cleaned?	Yes	Not required			
Space purged?	Yes	Not required			
Space atmosphere inert?	Yes	Not required			

RESCUE PROCEDURES

On-site rescue team available?	Yes	No
Outside assistance available and phone number verified?	Yes	No
Notification procedure: _____		

RESCUE EQUIPMENT TO BE AT ENTRY TO CONFINED SPACE

Entry into confined spaces where there is the potential for engulfment or where the atmosphere is IDLH is not allowed. Entry into a potentially IDLH atmosphere requires NIOSH approved positive pressure atmosphere supplying breathing apparatus or positive pressure airline respirator equipped with a 5-minute minimum emergency escape bottle.

AUTHORIZING SIGNATURES

NOTE: Your signature indicates that you have verified that the above information is correct and adequate and that you concur with the decision to proceed with the confined space entry work.

Person authorizing or in charge of the entry: _____

Attendant: _____

Site Manager: _____

Site Safety Officer: _____

[H&S-Forms-80]

11/92

CONFINED SPACE ENTRY PERMIT

Confined space to be entered: _____
Entry date and time: _____
Work to be done: _____
Authorized entrants: _____

Duration Permit is good for: _____
Conditions requiring new permit: _____

Entry into the confined space is permitted only by the persons noted above as authorized entrants into the specified confined space for the specific work noted.

CONFINED SPACE ATMOSPHERE TEST RESULTS

(to be completed immediately prior to entry)

% Oxygen (must be 19.5 - 23.5%): _____

% LEL (must be <10%): _____

PPM Other (specify substance): _____

Classification of confined space: _____

Tests performed by: _____

HAZARDS EXPECTED/KNOWN TO BE PRESENT

SPECIAL WORK PRACTICES/TOOLS TO BE USED

PERSONAL PROTECTIVE EQUIPMENT REQUIRED

Respiratory? _____

Clothing? _____

Other? _____

All entrants are to wear safety harness with life line attached.

AUTHORIZING SIGNATURES

NOTE: Your signature indicates that you have verified that the above information is correct and adequate and that you concur with the decision to proceed with the confined space entry work.

Person authorizing or in charge of the entry: _____

Attendant: _____

Site Manager: _____

Site Safety Officer: _____

K

IOPs

INSTRUMENT OPERATION PROCEDURE

HNu Model PI101 Photoionization Detector

**For the Detection of Organic Vapors
Through Photoionization**

January, 1991

INSTRUMENT OPERATING PROCEDURE HNu TRACE GAS ANALYZER MODEL PI 101

SCOPE AND APPLICATION

The Trace Gas Analyzer (See Figure 1), is a portable instrument used to detect, measure and provide a direct reading of the concentration of a variety of toxic gases in the air. The analyzer employs the principle of photoionization. The sensor consists of a sealed ultraviolet light (UV) source that emits photons with an energy level high enough to ionize many trace species, particularly organics.

The analyzer consists of a probe, a readout assembly, and a battery charger. The analyzer has a concentration range from 0 PPM to 2000 PPM.

Reference:

Instruction Manual Portable Photoionization Analyzer Model PI 101.

Apparatus:

HNu Model PI 101

Battery Charger

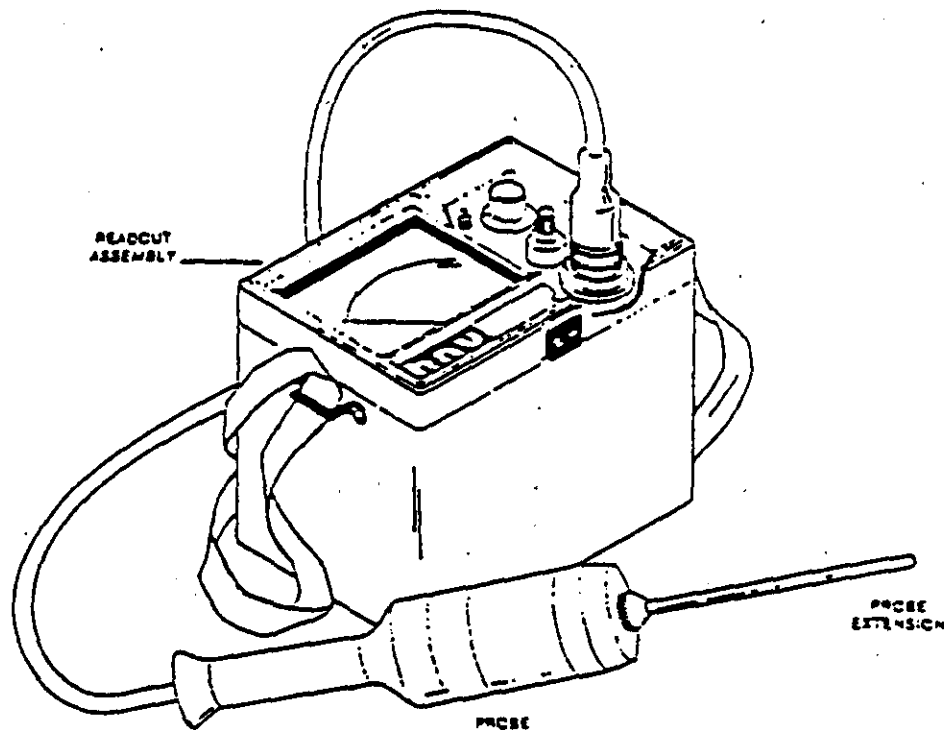
Probe options: 9.5 eV, 10.2 eV or a 11.7 eV UV lamps.

Calibration Kit - Kit containing a gas cylinder of isobutylene at concentrations of 52.1 PP and 59.7 PPM (check the concentration marked in the cylinder provided) for the 10.2 and 11.7 eV probe respectively, and a gas regulator.

1.0 DETAILED DESCRIPTION

1.1 Meter

Indications of the instrument are displayed on a meter, visible through a window on the top face of the instrument case (See Figure 2). A mark on the scale, "BATT CK", represents the minimum permissible battery voltage, as an indication of the state-of-charge of the battery. The meter face has a scale from 0 to 20.



TRACE GAS ANALYZER

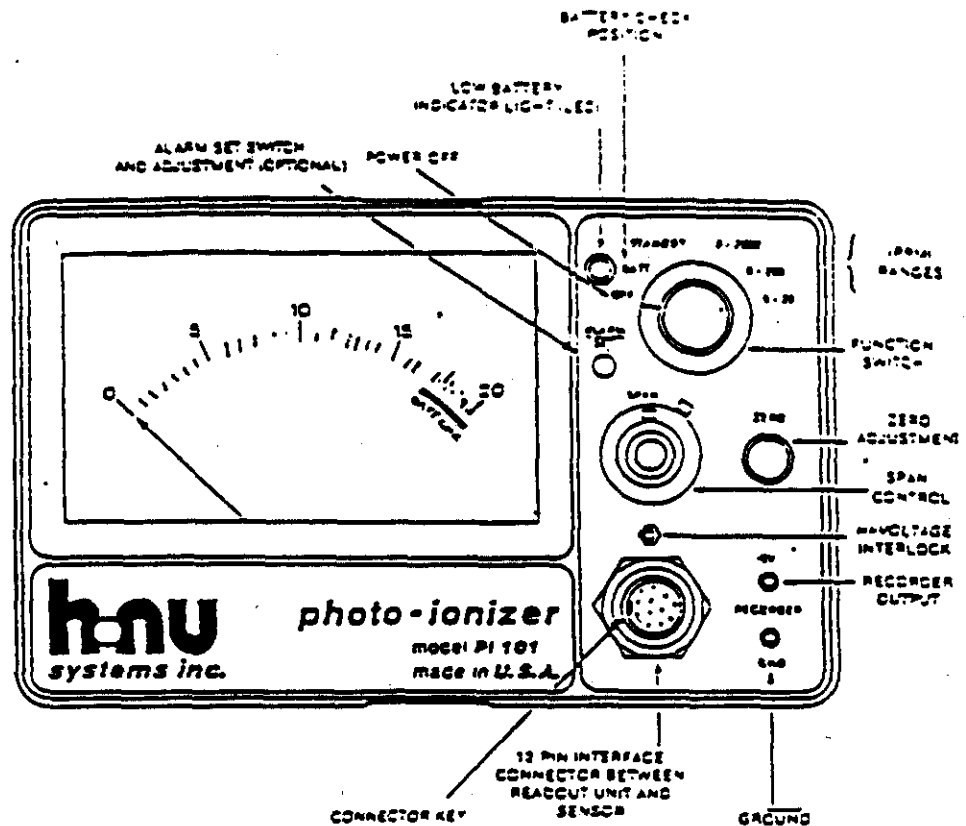
FIGURE 1

1.2 Controls and Indicators

The control and indicators are located on the front panel of the readout assembly (See Figure 2) and are as follows:

- 1.2.1 **FUNCTION** switch, a switch with six functions: OFF, BATT, STANDBY, and ranges of 0-2000, 0-200, and 0-20.

In the OFF position all operations are OFF; in the BATT position, checks the condition of the battery; in the STANDBY, all electronics are ON but the UV light source is OFF.



CONTROLS AND INDICATORS

FIGURE 2

- 1.2.2** ZERO adjustment, with the Function Switch in the STANDBY position, this potentiometer is used to adjust the reading to zero.
- 1.2.3** SPAN, this vernier potentiometer is used to set the gain of the amplifier to give direct readings of the trace gas concentrations in ppm. The whole number of the setting appears in the window of the control, decimal appears on the dial. A lock secures it at a specific setting.

- 1.2.4 **HI-VOLTAGE**, this is a normally open microswitch. Switch is open when cable not connected. Switch is automatically closed when the cable is attached. This switch may also be closed manually during maintenance checks of the readout assembly without the probe cable attached.
- 1.2.5 **ALARM SET** (optional), a potentiometer that turns the audible alarm ON and OFF and sets the ppm level at which the alarm sounds.
- 1.2.6 **LOW BATTERY INDICATOR LIGHT**, illuminates when the battery is discharged, indicates need for recharge. Readings may be taken while the unit is being recharged.
- 1.2.7 **RECORDER** (optional), provides a record of readings while analyzer operates unattended.

2.0 OPERATING PROCEDURES

The following procedures are to be used in operating the analyzer:

- 2.1 Unclamp the cover from the main readout assembly.
- 2.2 Attach the handle to the front part of the probe.
- 2.3 Connect the probe cable plug to the 12 pin keyed socket on the readout assembly panel (Figure 1). Carefully match the alignment slot in the plug to the key in the connector. Screw down the probe connector until a distinct snap and lock is felt.
- 2.4 Screw the probe extension into the probe end cap. The probe may be used without the extension if desired.
- 2.5 The SPAN control is set when the instrument is calibrated, refer to Section 3 below. Do not move this knob unless you are calibrating the instrument.

- 2.6 Turn the function switch to the BATT (battery check) position. The needle on the meter will go to the green zone if the battery is fully charged. If the needle is below the green arc or the Low Battery Indicator comes on, the battery must be recharged before the analyzer is used.
- 2.7 Turn the function switch to the STANDBY position. Turn the zero adjustment until the meter needle is at zero.
- 2.8 Turn the function switch to the appropriate operating position. Start with the 0-2000 ppm position and then switch to the more sensitive ranges. The UV light should be ON, confirmed by briefly looking into the probe to observe the purple glow from the lamp.

WARNING

Do not look at the light source closer than 6 inches with unprotected eyes.

Check that the fan is working properly by using a "Sharpie" marking pen; put the probe extension close to the tip of the pen and observe the needle deflect to the right. If the fan is not working return analyzer for repair.

- 2.9 The analyzer is now operational.
- 2.10 Hold the probe so that the extension is at the point where the measurement is to be made

WARNING

The instrument measures gases in the vicinity of the operator working in a breathing zone and a high reading when measuring toxic or explosive gases should be cause for action for operator safety.

- 2.11 Take the readings as desired taking into account that air currents, or drafts or power lines in the vicinity of the probe tip may cause fluctuations in readings. Change the ranges as required.
- 2.12 After completion of use, check battery condition as described in paragraph 2.6.
- 2.13 Turn function switch to OFF position.
- 2.14 When not operating, leave analyzer in assembled condition, and connected to battery charger.
- 2.15 When transporting, disassemble probe and extension from readout assembly and return equipment to its stored condition.
- 2.16 Calibrate daily as indicated in Section 3.

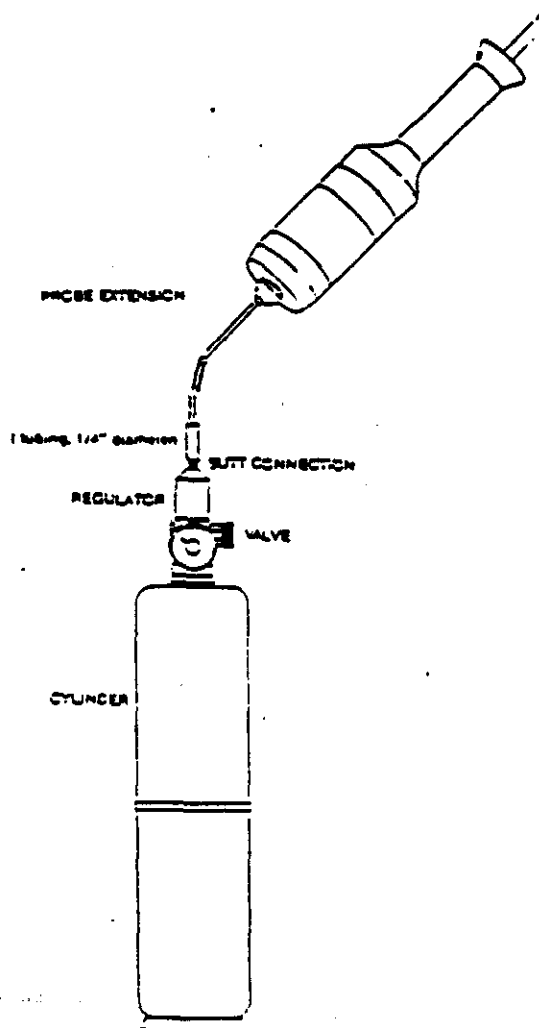
3.0 CALIBRATION

The PI 101 Analyzer is calibrated at HNU Systems with certified standards of benzene, vinyl chloride and isobutylene. The analyzer is calibrated in the field with a certified standard of isobutylene. The analyzer is designed for operation at ambient conditions and therefore the gas standards used for calibration should be delivered to the analyzer at ambient temperatures and pressure and at the proper flow rate.

3.1 Calibration Procedure

- 3.1.1 Turn the function switch to BAT. The needle should be in the green region. If not, recharge the battery.
- 3.1.2 Turn the function switch to STANDBY. In this position the the lamp is OFF and no signal is generated. Set the zero point with the ZERO set control.

- 3.1.3 Turn the function switch to the 0 -20 or 0-200 range. Adjust the SPAN control setting to 9.8 when using the 10.2 eV lamp and to 5.0 when using the 11.7 eV lamp. For calibration on this range only one gas standard is required.
- 3.1.4 Connect the calibration gas as shown in Figure 3. The small cylinder included with the HNU unit contains Isobutylene gas standard. With the 10.2 eV lamp, the concentration should be 52.1 PPM and with the 11.7 eV lamp the concentration should be 59.7 PPM. **NOTE:** Normally the cylinders indicate what concentrations to expect; make sure to check this before calibration.



CALIBRATION TEST SET UP

FIGURE 3

Turn the function switch to the range position and note the meter reading. Adjust the SPAN control setting as required to read the ppm concentration of the standard. Recheck the zero setting (step 3.1.2). If readjustment is needed, repeat step 3.1.4.

3.1.5 For calibration on the 0-2000 range, use of two standards is recommended. First calibrate with the higher standard using the SPAN control for setting. Then calibrate with the lower standard using the ZERO adjustment. Repeat these several times to ensure that a good calibration is obtained.

3.1.6 If the span setting resulting from calibration is 0.0 or if calibration cannot be achieved, the lamp then must be cleaned (see section 4).

3.1.7 Shut off the cylinder as soon as the reading is established.

3.1.8 The analyzer is ready to take measurements.

4.0 MAINTENANCE

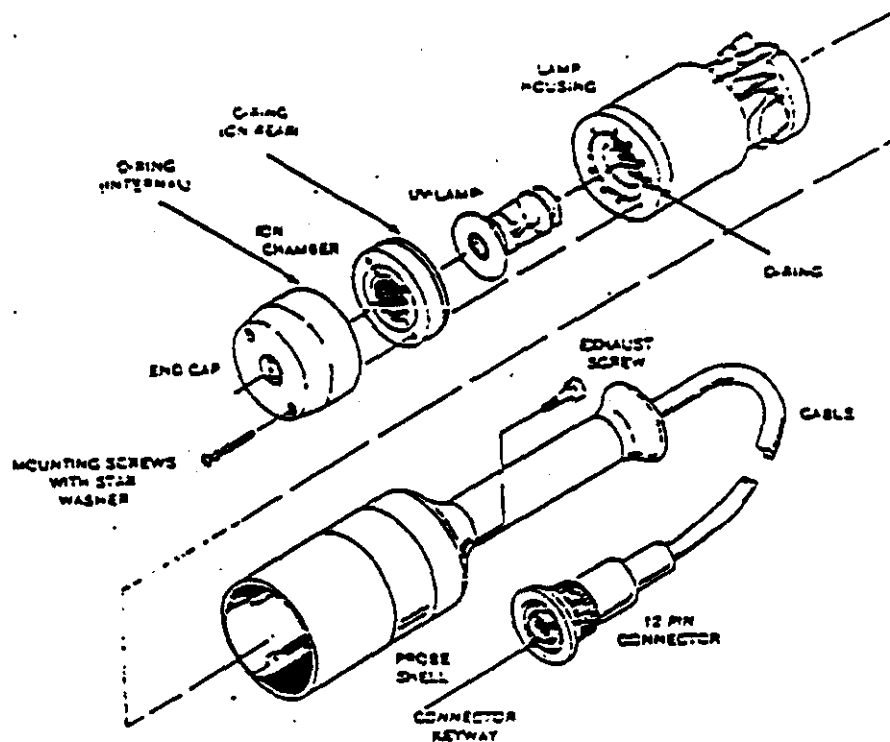
Maintenance of the analyzer consists of cleaning the lamp, the ion chamber and the fan. During operation of the analyzer, dust, moist or other foreign matter can be drawn into the probe forming deposits on the surface of the UV lamp or in the ion chamber. This condition is indicated by meter readings that are low, erratic, unstable, non-repeatable, or drifting, or show apparent moisture sensitivity.

4.1. UV Lamp and Ion Chamber Cleaning.

Disassemble the probe by first removing the exhaust screw at the base of the probe adjacent to the handle (See Figure 4). Grasp the end cap in one hand and the probe shell in the other, gently pull to separate the end cap and the lamp housing from the shell.

Hold the lamp housing with the black end cap upright. Loosen the screws on the top of the end cap, separate the end cap and ion chamber from the lamp and lamp housing.

Remove the probe from the retaining ring. Clean the probe with a dry cloth. A dry cotton swab, dry cloth, or paper towel can be used. Let the probe dry before reassembly.



PROBE ASSEMBLY

FIGURE 4

CAUTION

Care must be taken so that the ion chamber does not fall out of the end cap or the light source does not fall out of the lamp housing.

Turn the end cap over in the hand. Tap lightly on the top. The ion chamber should fall out of the end cap into the hand. Place one hand over the top of the lamp housing and tap slightly. The light source will slide out of the housing.

Exercise great care in doing so to prevent inadvertent damage to these components.

4.1.1 For the 9.5 and 10.2 eV lamps:

- a. First clean by rubbing gently with lens tissue dipped in a detergent solution. If this does not remove deposit, apply a small amount of HNU cleaning compound (PA101534) directly onto the lens of the lamp and spread evenly over surface with a non-abrasive tissue.
- b. Wipe off compound with a new tissue.
- c. Rinse with warm water or damp tissue to remove all traces of grit or oils and any static charge that may have built up on the lens. Dry with a new tissue.
- d. Reinstall lamp in the detector and check analyzer operation. If performance is still not satisfactory replace the lamp.

4.1.2 For the 11.7 eV lamp:

- a. Clean by putting a freon or chlorinated organic solvent on a tissue and rubbing gently.
- b. **DO NOT CLEAN THIS LAMP WITH WATER OR ANY WATER MISCIBLE SOLVENTS (such as methanol or acetone). IT WILL DAMAGE THE LAMP.**
- c. **DO NOT USE THE CLEANING COMPOUND USED FOR THE 9.5 OR 10.2 eV LAMPS.**

4.2 Ion chamber Cleaning.

Inspect the ion chamber for dust or particulate deposits. If such a matter is present, the chamber can be cleaned by removing the outer Teflon ring, and the four screws holding the retaining ring. Carefully remove the retaining ring aside (Note: this ring is soldered) and remove the screen. A tissue or cotton swab, dry or wetted with methanol, can be used to clean any deposits. Let the liquid dry before reassembly.

Reassemble the probe and check analyzer operation. If performance is still not satisfactory replace the lamp.

4.3 Fan Cleaning

Remove the pogo contacts and the retaining screw shown in Figure 5.

- a. Lift up top supporting fan and slowly pull fan out. CAUTION: the fan does not come out all the way; it is attached to the wires.
- b. Blow into the fan to remove any dust particles. If the fan does not move freely, check for any larger particles that can be removed without damaging the impellor rotor or the blades.
- c. Check for wiring connections at fan motor and at probe cable connector (J3 pins A and C).

Reassemble the probe by first sliding the lamp back into the lamp housing. Place the ion chamber on top of the lamp housing, making sure that the contacts are properly aligned. The ion chamber fits only one way.

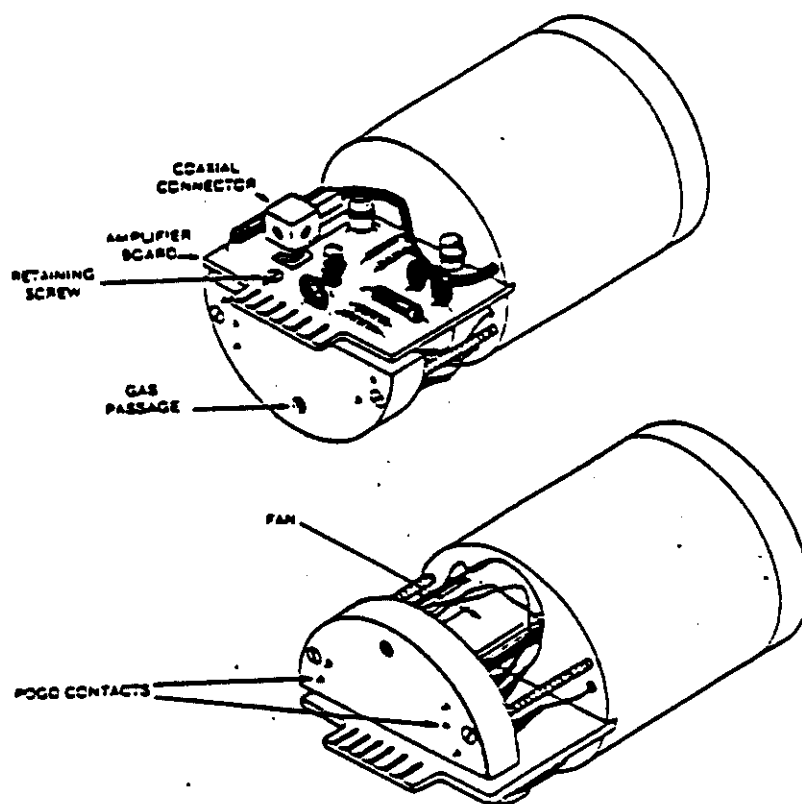
Reassemble the probe by first sliding the lamp back into the lamp housing. Place the ion chamber on top of the lamp housing, making sure that the contacts are properly aligned. The ion chamber fits only one way.

Place the end cap on top of the ion chamber and replace the two screws. Tighten the screws only enough to seal the O-ring.

CAUTION

Do not over-tighten these screws.

Line up the pins (pogo contacts) on the base of the lamp housing with the pins inside the probe shell. Gently slide the housing assembly into the probe shell. The end cap should meet the probe shell evenly after final assembly. If not, the ion chamber may be installed wrong.



FAN/LIGHT SOURCE ASSEMBLY

FIGURE 5

CAUTION

DO NOT FORCE the assembly into the shell. It fits only one way.
If it does not reassemble readily, remove the check pin alignment. Check to ensure pogo contacts are not bent. Refasten the exhaust screw at the base of the probe.

INSTRUMENT OPERATION PROCEDURE

COMPUR Model 4100SD MONITOX HCN Detector

For the Detection of Hydrogen Cyanide Gas

January, 1991

SECTION 1

SCOPE AND APPLICATION

The COMPUR Model 4100SD (MONITOX) is a personal monitor for hydrogen cyanide (HCN). It is designed to be worn attached to the clothing near the breathing zone of the person being monitored. The detector produces an audible first alarm when the HCN concentration exceeds the threshold limit value (TLV), set by the manufacturer at 10 PPM and a second alarm when the HCN concentrations exceeds twice the TLV.

REFERENCE

MONITOX Model 4100SD Reference Manual

APPARATUS

- MONITOX Model 4100SD Detector
- HCN Gas Generator

THEORY OF OPERATION

Ambient air diffuses through the dust-filter insert to the measuring cell. The measuring cell, a dual-electrode electrochemical cell with an organic electrolyte gel, generates an output current proportional to the partial pressure of hydrogen cyanide (HCN) in the air.

A series of electronic amplifiers supply a voltage signal which is fed to the comparator for the alarm threshold. If the first alarm threshold is exceeded, an intermittent tone produced. If the second alarm threshold is exceeded a dual-tone signal is sounded.

SECTION 2

OPERATION

2.1 BATTERY TEST

Turn the switch on the MONITOX to BATT. If the battery has sufficient power to operate the detector for eight hours, an intermittent tone will be heard. There should be no LCD display. If no tone is emitted, this indicates that the batteries need to be replaced. To preserve the batteries, this test should be as short as possible.

2.2 OPERATION

2.2.1 After the BATT test tone has been heard, quickly move the switch to ON. The tone will cease. Stopping the BATT test tone as quickly as possible will preserve the battery power. The LCD display is operating now. It must show 0 PPM after a few seconds for proper operation.

2.2.2 The gas detector must be worn in the breathing zone of the person to be monitored. The filter cap should not be covered in any way. The rubber lip on the carrying clip makes it possible to securely attach the MONITOX to articles of clothing (e.g., the breast pocket).

2.2.3 The filter cap should be protected from water, dust-laden air and dirt. Both the battery and functional tests should be performed before the detector is put into operation.

2.2.4 If the HCN-gas concentration in the vicinity of the sensor exceeds the set alarm value, the alarm will sound after a delay, which is dependent on the gas concentration. The higher the concentration, the more quickly the MONITOX will respond.

SECTION 3

FUNCTIONAL TEST

The MONITOX detector must undergo a functional test using the HCN-gas generator before each use. This test procedure is necessary to check the MONITOX gas detection and warning system. The generation of HCN gas in a concentration above the TLV checks the detector for response. The gas generator, however, is not designed to generate a calibration gas of known concentration.

The switch on the generator is activated by placing the detector in the matching recess on the generator head. A small fan feeds a flow of air past the generator cell directly to the detector cell. Within ten seconds, HCN gas is generated at sufficient concentration to cause the detector to respond (The alarm threshold is 10 PPM). After a ten second interval, HCN production is terminated and the fan conveys pure air until the detector is removed. The period of gas generation is indicated by the green LED. The red LED indicates when the battery must be replaced.

This functional test of the detector checks the following defects:

- clogging of the dust filter
- malfunctioning cell
- malfunctioning electronics system
- malfunctioning generator

3.1 Turn-on and warm-up the MONITOX. Place it on top of the HCN generator as illustrated in Figure 1.

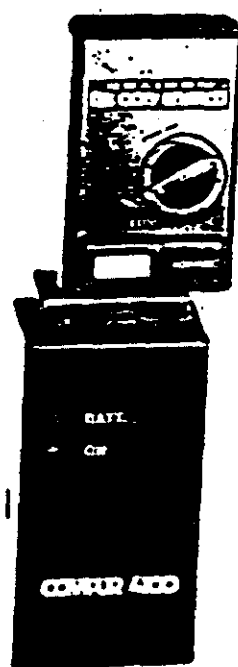


FIGURE 1

3.2 As soon as the detector alarm sounds, it must be removed from the generator. The detector is ready for operation once the alarm has ceased.

3.3 If the detector alarm does not sound within ten seconds the detector has to be checked and serviced. If necessary, the filter cap has to be replaced.

3.4 The battery and functional tests must be performed prior to each use to ensure maximum safety.

3.5 During the gas test the LCD display must show the response of the cell to HCN concentration as well. As the alarm threshold is factory-set at 10 PPM, the alarm should sound at 10 PPM. As the display reads a new value every second, the time for alarm and display of 10 PPM may be different.

SECTION 4

MAINTENANCE AND TROUBLESHOOTING

4.1 If the battery alarm does not sound during the battery check, replace the battery of the unit.

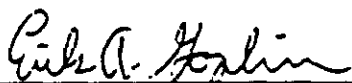
4.2 If, during the calibration test, the alarm does not sound at 10 PPM or the display does not read 10 PPM, either the MONITOX and/or the hydrogen cyanide generator need to be repaired.

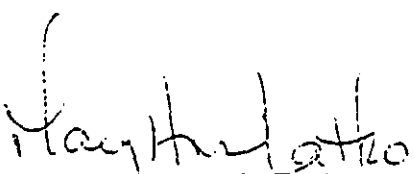
4.3 The generator cell may dry out at very low relative humidity in air. Always put the moisture cap on top of the generator when it is not in use. This ensures a correct gas concentration for the detector test.

4.4 If no response is obtained during the calibration test. Check and see if the filter cap of the MONITOX is dirty and needs to be replaced.

4.5 If the red LED of the HCN generator lights during the calibration test replace the generator batteries.

NOTE The MONITOX is sensitive to sulfur dioxide, nitrogen dioxide, ammonia, chlorine, hydrochloric acid and hydrogen sulfide. The presence of HCN must be verified through the use of colorimetric tubes if any of these gases are suspected to be present.


Erik A. Goplin
Loss Control Specialist


Mary Ann Laiko, CSP
Corporate Health and Safety Manager

INSTRUMENT OPERATION PROCEDURE

INDUSTRIAL SCIENTIFIC Model HMX271 Multi-Gas Meter

**For the Detection of Oxygen,
Hydrogen Sulfide, and
Explosive/Combustible Gases**

January, 1991

SCOPE AND APPLICATION

The Industrial Scientific Model HMX271 Multi-Gas Meter is a hand held battery-powered instrument that simultaneously monitors ambient levels of oxygen, hydrogen sulfide, and combustible gases in air. The unit is equipped with a digital display and audible alarms that sound whenever the above gas concentrations reach preset levels.

REFERENCE

Instruction Manual Industrial Scientific Model HMX271

APPARATUS

Multigas Meter Model HMX271

Calibration Cap

Battery Charger

Model SP200 Sampling Pump

Dust Filter

Water Filter

Tygon Tubing

Calibration Kit - Kit containing cylinders of hydrogen sulfide and methane

1.0 DETAILED DESCRIPTION

The HMX271 Meter is a diffusion-type air sampler. Concentrations of oxygen, hydrogen sulfide and combustible gases are detected as they diffuse through the associated detectors within the housing of the unit. A sampling pump attachment allows remote sampling and continuous monitoring in areas where it is unsafe to enter.

1.1 Monitor

The unit has a liquid crystal display (see Figure 1). All three gases are monitored simultaneously; only one is displayed at a time. When one of three membrane switches located immediately below the LCD panel is touched, the respective gas readout will appear on the display. A small triangular pointer also appears on the display, just above the switch that was pressed, to indicate which gas is being displayed. The last gas selected will remain on display until a different switch is pressed. The readout for the three gases may be selected in any sequence that the user desires. When the instrument is first turned on it will automatically display the oxygen readout.

Combustible gases are displayed in percent of lower explosive limit (LEL) in 1% LEL increments. Hydrogen Sulfide (H_2S) in parts per million (ppm) in 1 ppm increments, and oxygen (OX) in percent by volume in 0.1% increments.

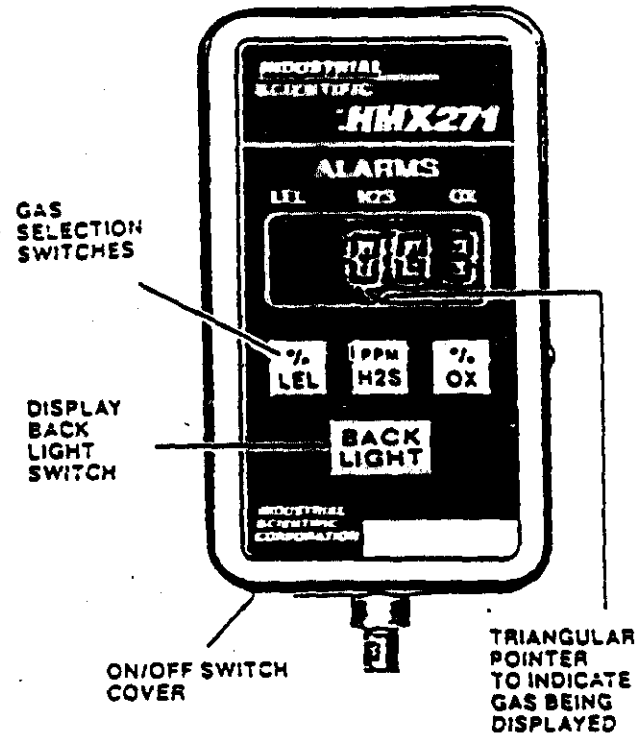


FIGURE 1

1.2 Alarms

Although only one gas can be displayed at a time, all of the alarm circuits are active and continuously monitoring for unsafe conditions. If any of the gases reach a preset safety limit, the audible and visual alarms are activated immediately. The audible alarm is a high pitched tone that alternates between two frequencies at the rate of approximately two times per second. A rectangular LCD enunciator appears near the top of the display panel to indicate which gas or gases caused alarm activation. The LCD will continue to display the readout of the gas range last selected by touching one of the membrane switches.

2.0 OPERATION

2.1 Switching ON the Instrument (see Figure 2)

To switch on the instrument:

2.1.1 Back off the knurled nut that holds the calibration cover in place.

2.1.2 Rotate the cover so that the metal button is inserted in the oval-shaped hole.

2.1.3 Tighten the nut until the calibration cover is flush with the case. Do not over tighten.

2.1.4 The monitor is ready for use as soon as the display stabilizes (approximately 60 seconds).

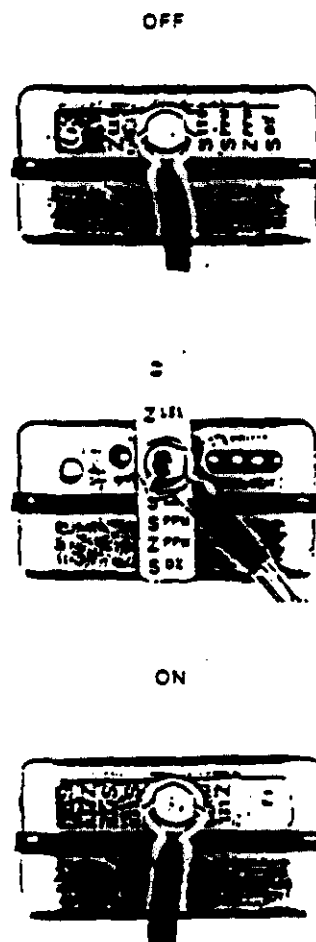


FIGURE 2

2.2 Switching OFF the Instrument (see Figure 2)

To switch off the instrument:

2.2.1 Back off the knurled nut that holds the calibration cover in place.

2.2.2 Rotate the cover so that the metal button is inserted in the unmarked round hole

2.2.3 Tighten the nut until the calibration cover is flush with the case. Do not over-tighten.

3.0 CALIBRATION

3.1 Checking Alarm Settings

3.1.1 Turn the calibration cover ninety degrees to expose the five calibration adjustments at the side of the instrument (see Figure 3).

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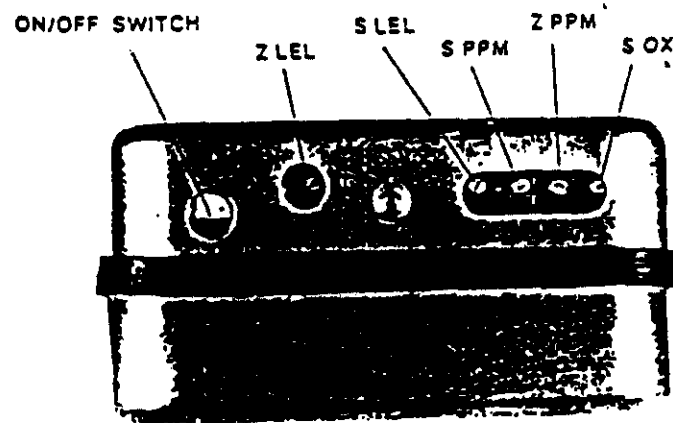


FIGURE 3

3.1.2 To check the LEL alarm setting, switch the display to the LEL mode. Slowly turn the Z LEL (LEL zero offset) adjustment in the clockwise direction until the alarm is activated. When the alarm point is reached, slowly turn the adjustment back and forth through the point at which the alarm is activated. Observe the display. The display will show the percent of LEL at which the alarm is set to activate. Turn the adjustment back to the zero display reading. The factory setting for the LEL alarm is 10%.

3.1.3 Switch the display to the H₂S mode and slowly turn the Z PPM (H₂S zero offset) adjustment in the clockwise direction until the alarm is activated. Slowly turn the adjustment back and forth through the point of activation and observe the display for the ppm level at which the H₂S alarm activates. Turn the adjustment back to the zero display reading. The factory setting for the hydrogen sulfide alarm is 10 ppm.

3.1.4 Unlike the LEL and H₂S, the OX section does not require a zero adjustment. After switching to the OX mode, observe and note the display reading, which should be 20.9% in normal room air. Slowly turn the S OX (OX calibration) adjustment counterclockwise until the low oxygen alarm setting is reached. Slowly turn the adjustment back and forth through the alarm point to verify the setting. After the low alarm setting is located, slowly turn the adjustment in the clockwise direction until the high oxygen alarm setting is found. Slowly turn the adjustment back and forth through the alarm point to verify the setting. The oxygen alarms are factory set at 19.5% for the low alarm and 23.0% for the high alarm.

3.2 Zero Calibration

3.2.1 In clean air, switch the display to the H₂S mode and adjust the Z PPM (H₂S zero offset) by turning it counterclockwise until the minus sign (-) appears in the display. Very slowly turn the Z PPM control clockwise until the minus sign just goes off, leaving (000) in the display.

3.2.2 In clean air, switch the display to the LEL mode and adjust the Z LEL (LEL zero offset) control by turning it counterclockwise until the minus sign (-) appears on the display. Very slowly turn the Z LEL control clockwise until the minus sign just goes off, leaving (000) in the display.

3.2.3 There is no oxygen zero calibration.

3.3 Span Adjustments

3.3.1 Switch the display to the LEL mode, and apply the LEL span gas to the monitor using the calibration cup (see Figure 4). Allow the gas to flow for two (2) minutes. With the gas still flowing, adjust the S LEL (LEL span sensitivity) control, on the bottom of the instrument, so that the display reads the percent of LEL, to the nearest percent, that is printed on the calibration gas cylinder. Remove the calibration gas.

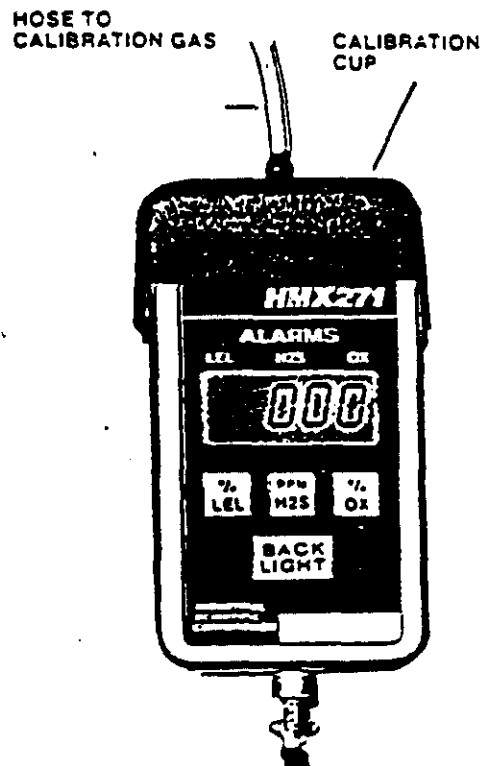


FIGURE 4

3.3.2 Repeat the above procedure for H_2S using a known concentration of hydrogen sulfide span calibration gas with the S PPM (H_2S span sensitivity) control to complete the span calibration.

3.3.3 In clean air, known to have 20.9% oxygen, the S OX (OX span sensitivity) control should be adjusted so that the display reads 20.9% oxygen. Final calibration of the oxygen readout should only be done in free air if the user is sure that the air contains the normal 20.9% oxygen. The readout should then be adjusted so that the display reads 20.9%. If there is any doubt of the oxygen content of the air, calibration gas of a known percentage of oxygen in nitrogen should be used.

4.0 USE OF THE SAMPLING PUMP MODEL SP200

The SP200 Sampling Pump can be used for remote sampling when it is unsafe for the instrument user to enter the area where an atmospheric determination is to be made. The SP200 is also useful for testing otherwise inaccessible areas (see Figure 5).

The pump is powered by a nickel cadmium battery pack that provides a minimum of hours of continuous operation. Battery chargers are available to charge the SP200's batteries. An external, user replaceable dust filter is designed to protect internal pump parts.

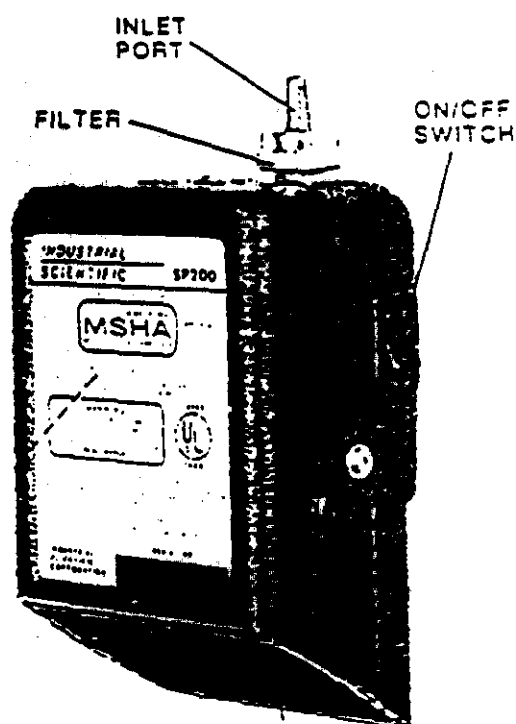


FIGURE 5

4.1 Sampling Pump Model SP200 Operation

4.1.1 Connect the flowmeter as shown in Figure 6. Verify that the flowmeter is vertical. Turn the pump on. The pump is working properly if the flowmeter ball is in the green region. Under normal operation, the ball may be moving in the green region. If the ball is in the red region, the pump must be serviced before use.

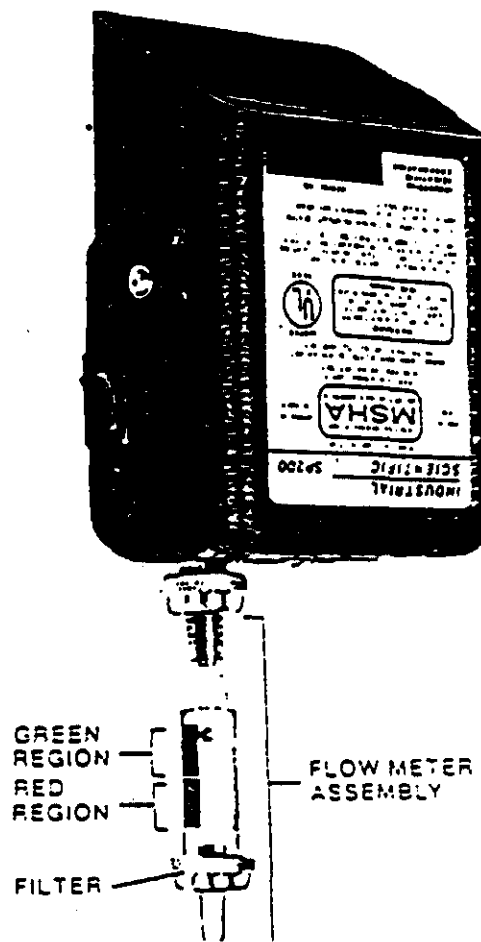


FIGURE 6

NOTE: The flowmeter should be left in the sampling line during sampling and should be checked periodically.

4.1.2 Fit the SP200 over the sensor end of the HMX271 instrument. Push the instrument into the pump cavity as far as possible. This is a tight fit; therefore, you may need to "rock" the instrument into position. There will be gaps between the SP200 and the instrument; these serve to prevent sensor pressurization.

4.1.3 Slip the remote sampling hose over the SP200 hose connector. Turn on the SP200. Allow 2 seconds per foot of hose length for the sampling line to be purged before reading the concentration (maximum sampling hose length is 100 feet).

4.1.4 If the pump motor is heard to stall or slow noticeably during use, there may be a blockage in the sample draw hose, or the external filter(s) may be clogged and need to be replaced. Withdraw the hose, clear the blockage and/or replace the filters, and test the unit as described in section 5.2.4 before resuming operation.

NOTE: Do not operate the SP200 without the external dust filter.
Pump damage may result.

The SP200 will lift a vertical column of water 33 to 37 inches before the pump motor will stall. The pump will draw liquid over a much longer distance if the hose is not vertical. If liquid is drawn into the pump, internal SP200 components may be damaged.

4.1.5 A water filter should be used if the pump will be operated in areas where liquid can be drawn into the sampling hose. The water filter should be inserted into the end of the sampling hose (tapered end into hose) prior to sampling. This will prevent liquid from being drawn into the pump.

4.1.6 If the water filter is dropped in liquid, it will block the sample from entering into the hose and will restrict sample flow. If this occurs, withdraw the hose, tap or shake the water filter to remove the liquid, and test the unit as described in Section 4.1.1 before resuming operation.

4.1.7 If the pump will not operate after attempting to remove the liquid from the water filter, remove the water filter from the hose. If the flow increases, the water filter is clogged and should be replaced.

4.1.8 The water filter may also be used as an auxiliary filter in very dusty atmospheres.

5.0 MAINTENANCE

5.1 Maintenance of HMX271

5.1.1 Turn the instrument OFF when charging.

5.1.2 A completely discharged battery's full potential will be restored by 14 hours of charging. Apparent reductions in battery capacity may result from repetitive use patterns. A fully charged battery that does not deliver energy for at least 10 hours continuous monitoring may have developed "memory" condition. To eradicate this, entirely discharge (until low battery warning) and then fully charge the battery. The memory effect can be avoided by using the HMX271 so that the battery is discharged to varying depths.

5.1.3 Typical run time will be approximately 12 hours. When the battery nears the end of its useful charge life (approximately 1/2 hour of operating time remaining), the monitor will start to emit short audible tone bursts to warn of a low battery condition. The tone bursts are two to three minutes apart and about one to five seconds in duration increasing in length as the end of battery life approaches.

5.1.4 When the battery is no longer capable of supplying sufficient power to the monitor, the monitor will go into the battery failure mode. The battery failure mode is indicated by all of the display digits being blanked except for the numeral (1) in the far left position; the word LOBAT appears in the upper left corner of the display and the audible alarm sounds a continuous high pitched tone. The above condition will continue for approximately 10 minutes or until the monitor is switched off. A 14 hour charging is needed to restore the battery to a full charge condition.

NOTE: After the monitor goes into the battery failure mode, it should be switched off within a few minutes. If the unit is not switched off within ten minutes, inaccurate fluctuating readings will appear on the display and serious battery damage may result.

5.2 Maintenance of the Model SP200 Sampling Pump

The SP200 requires no regular maintenance except for charging the batteries and periodic replacement of the filters.

5.2.1 A completely discharged battery will be restored to full capacity by 14 hours of charging with the single-unit charger. The same charger that is used for the HMX271 is used to charge the SP200 sampling pump.

5.2.2 An apparent reduction in battery capacity may result from repetitive use patterns. A fully charged battery should provide a minimum of 10 hours of continuous operation. A fully charged battery that does not provide 10 hours of continuous operation may have developed memory" condition. To eliminate this memory:

1. Discharge the battery until the motor speed drops noticeably. Do not discharge beyond this point.
2. Turn the pump off and charge for a minimum of 14 hours.
3. If, after repeating this procedure one more time, this pump will still not run for 10 hours, replace the battery pack.

5.2.3 Battery life can be maintained by the following procedure:

1. Discharge the battery to different degrees before each charging.
2. Charge the battery only when the motor begins to slow down.
3. Never allow the battery to become fully discharged.

5.2.4 To test the dust filter for proper operation:

1. Switch on the pump.
2. Verify that the flowmeter ball is in the green area. If not, replace the dust filter and re-test.
3. If the ball is in the green area, note the relative position.
4. Unscrew the flowmeter filter.
5. If the ball rises higher in the green area (by the diameter of the ball or more) replace the filter and re-test.

6.0 PRECAUTIONS AND NOTES ON OPERATION

6.1 Any rapid up-scale reading followed by a declining or erratic reading, or reading greater than 100% LEL, may indicate a gas concentration beyond the accurate response range of the LEL detector. Either take immediate corrective action to eliminate this potential hazard; or, withdraw from it.

6.2 Readings that are either negative or greater than 100% LEL may indicate an explosive concentration of combustible gas.

6.3 Obstruction of the screened sensor ports will cause erroneous low readings. These screens must be kept clean.

6.5 Oxygen deficient atmospheres will cause erroneous low determinations of the combustible gas content of the air.

6.6 Oxygen enriched atmospheres will cause erroneous high determinations of the combustible gas content of the air.

6.7 Verify the calibration of the combustible detecting mode of the instrument after use where the combustible gas content as a percent of the LEL was 100% or greater. Long continuous use at high LEL concentrations (50% to 100%) may cause damage to the LEL detector, resulting in reduction of sensitivity and erratic behavior, including inability to calibrate. If this occurs, the LEL detector should be replaced.

6.8 Silicone compound vapors and sulfur compound vapors will cause desensitization of the LEL detector and this can cause erroneous low determinations. Verify the calibration of an instrument that has been used where these vapors were present before that instrument is relied upon for accurate measurements. Replace the LEL detector if the instrument cannot be calibrated.

6.9 Changes in the total pressure of the atmosphere due to changes in altitude will bear on the instrument's determination of the air's oxygen content. Calibrate the oxygen monitor mode of the HMX271 at the altitude at which it will be used.

6.10 If the unit cannot be calibrated according to the specification or gives erratic or inconsistent readings, the unit must be sent in for repairs.

EAG/mr/MAL
[SAFETY:IOPS Ind Sci Model HMX271]

PROJECT
99100.88

INSTRUMENT OPERATION PROCEDURE

**THERMO ENVIRONMENTAL MODEL 580B PHOTOIONIZATION DETECTOR
FOR DETECTION OF ORGANIC VAPORS
THROUGH PHOTOIONIZATION**

JANUARY 1992

PREPARED BY:
WARZYN INC.
MADISON, WISCONSIN

INSTRUMENT OPERATING PROCEDURE

THERMO ENVIRONMENTAL

MODEL 580B

SCOPE AND APPLICATION

The Model 580B (See Figure 1), is a portable instrument used to detect, measure, and provide a direct reading of the concentration of a variety of toxic gases in the air. The analyzer employs the principle of photoionization. The sensor consists of a sealed ultraviolet light (UV) source that emits photons with an energy level high enough to ionize many trace species, particularly organics. The unit can display maximum readings, log data, average readings and download data to a computer or printer.

The analyzer consists of a probe, a readout assembly, and a battery charger. The analyzer has a concentration range from 0 PPM to 2000 PPM.

Reference

Instruction Manual Thermo Environmental Model 580B.

Apparatus

Thermo Environmental Model 580B.

Battery Charger

Lamp options: 10.0 eV, 10.6 eV or 11.8 eV

Calibration Gas - A gas cylinder of isobutylene at concentrations between 50 and 100 PPM (check the concentration marked in the cylinder provided).

1.0 DETAILED DESCRIPTION

See Figure 2 for the features described below.

1.1 Power Plug

The power plug is used to run the instrument from its internal batteries. There is a chain attached to the power plug so that it will not be lost.

1.2 RS-232 Connector

This connector is used for communication with a serial printer or computer. A communication cable provided with the instrument fits into the receptacle.

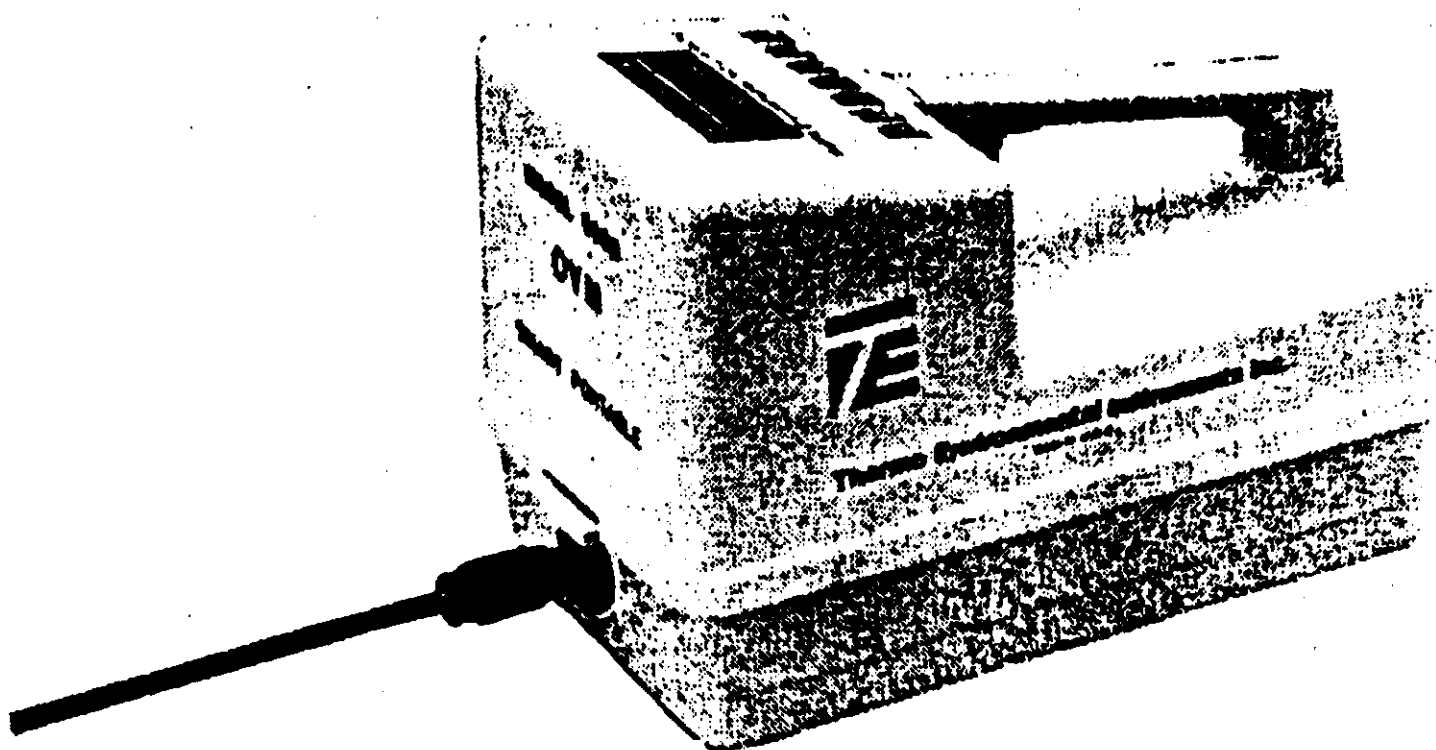


Figure 1
Model 580B

1.3 Key Pad

There are seven switches which operate the 580B. The switch marked On/Off is used to run the pump and lamp on and off. The switch marked LIGHT will turn on backlighting for the two line display. The other five switches perform various functions.

1.4 Display

The 580B has a two line by sixteen character display.

1.5 Shoulder Strap

There is an adjustable shoulder strap for carrying the 580B.

1.6 Sample Exit Port

The 580B sample is drawn into the detector by a positive displacement pump and then sent back out through the exit port.

Note: The photoionization detector is a non destructive detector so the sample may be collected at the exit for further analysis.

1.7 Pump

The 580B pump draws the sample into the detector.

1.8 Mounting Screws

There are four captive screws which hold the 580B top and bottom together. The screws are specially designed so that they do not fall out when they are loosened out of the case top.

1.9 Detector

The photoionization detector is shown with the lamp and high voltage power supply.

1.10 Sample Inlet

Sample is drawn into the detector through the sample inlet at the front of the 580B.

1.11 Signal Cable

The PID signal is brought up to the microprocessor, for analysis, via the coaxial signal cable.

1.12 Base Harness

The base harness plugs into a connector on the case top.

[mad-603-52]

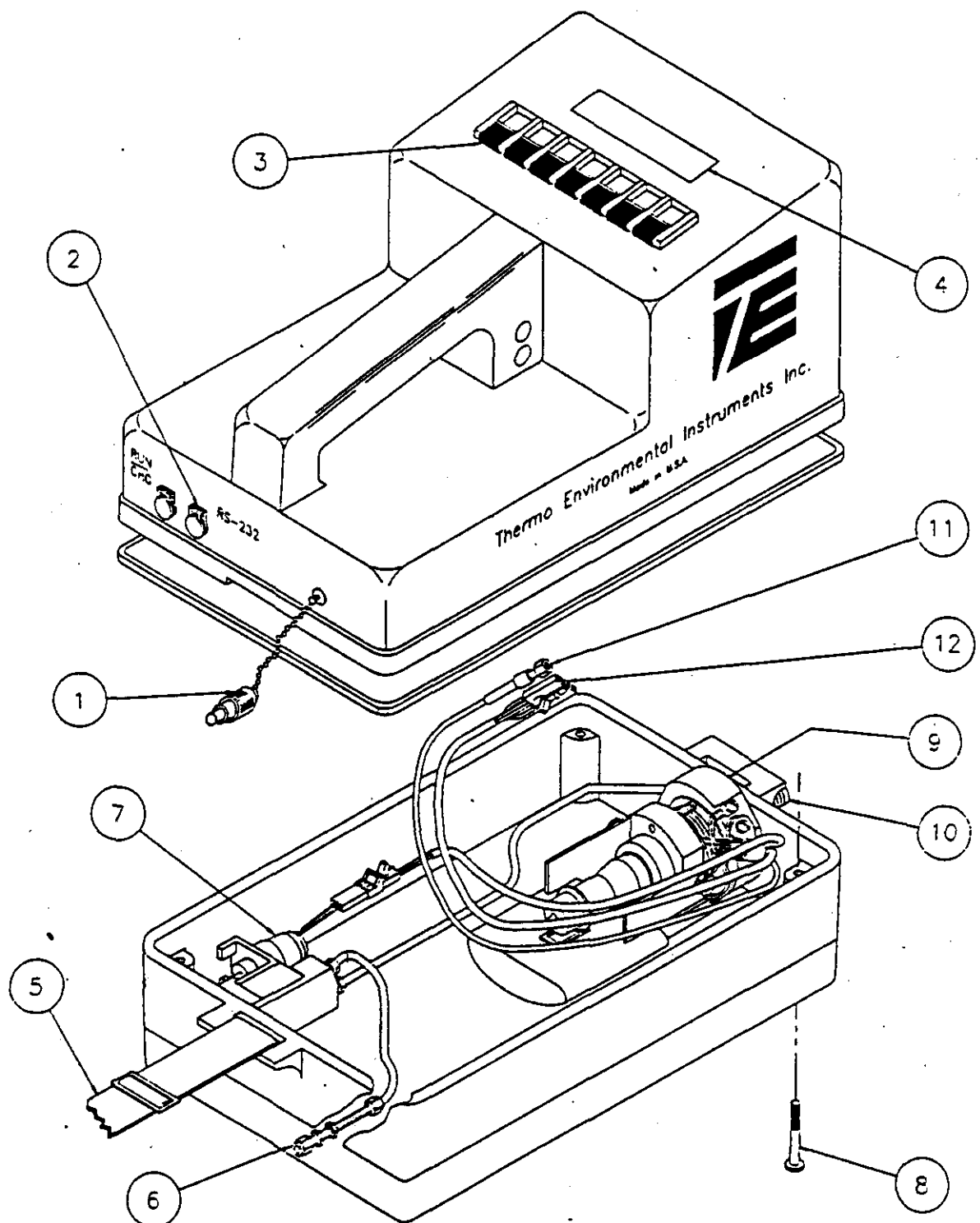


Figure 2
Instrument Features

OPERATING PROCEDURES

The following procedures are used for basic operation of the unit.

2.1

Place the small porous dust trap in the recess of the probe extension. Screw the probe onto the front port of the instrument. **Note: The dust trap must be used at all times.**

2.2

Place the Power plug, hooked to the chain, in the receptacle marked RUN/CHG on the back of the unit. This powers the display.

2.3

Turn on the pump and lamp on by pressing the ON/OFF switch. The unit is now reading the real time organic vapor concentration on the bottom part of the display.

2.4

Changing between maximum and bar graphs reading.

Once the unit is on, the top line of the display may be a bargraph or a display showing the highest concentration recorded. To change from one mode to the other, the following procedure should be used.

2.4.1

Press the MODE/STORE key.

2.4.2

Press the -/CRSR key at the prompt asking if logging is desired. The display will read:

R/COMM
+/ACCESS

-/PARAM
S/CLOCK

2.4.3

Press the -/CRSR key to choose -/PARAM. This puts the unit in the parameters mode. The top display will read CONC. METER and the bottom line will read "RESET" to CHG. The bottom line will alternate every two seconds with MAXHOLD if the unit is currently in the maximum hold mode.

2.4.4

Press RESET and the display will read:

MAXHOLD
+ = use/- = NO

If the +/INC switch is pressed, the unit will be in the Maximum Hold Mode. If the -/CRSR switch is pressed, the unit will be in the bargraph mode.

2.4.5

Press the MODE/SWITCH key to get back to the RUN Mode.

2.5 Logging Data

2.5.1

Readings can be stored for later analysis. Each reading will have a date, time, and location code associated with it. Up to 700 readings may be stored.

The log mode is entered by pressing the MODE/STORE switch. The top display will read:

LOG THIS VALUE?

The bottom line will read PPM or MAX PPM depending on the current run mode.

2.5.2

Press +/INC and the display will show:

LOC.CODE

followed by a six digit number.

2.5.3

The location code number can be changed by pressing the +/INC switch to change the number above the cursor as desired. Use the -/CRSR switch to move the cursor as desired.

2.5.4

Once the desired location code is entered, press the **MODE/STORE** switch to log the data point. The 580B automatically increments the location code each time a data point is logged.

2.6 Speaker

While in the Run Mode, the speaker may be turned on or off by pressing **SPKR**. When the speaker is on a "clicking" will be heard which increases frequency as the readings increase. The alarm will also sound when the alarm threshold is exceeded. When the speaker is off there is no "clicking" and the audio alarm does not sound. The display will still read **ALARM** when the alarm threshold is exceeded.

2.7 Low Battery

The 580B will display a flashing **B** in the left hand corner when the battery is low. The battery should be recharged when the low battery signal is displayed.

2.8 Overrange

The 580B will display:

OVERRANGE

whenever the concentration exceeds 2000 PPM. The unit must be removed to an area with organic vapors below 20 PPM before the regular display returns.

2.9 Light

When pressing the **LIGHT** switch the display is illuminated so readings can be obtained in low light areas.

2.10 Setting the Alarm Level

The alarm can be changed to any desired level from 1-2000 PPM by performing the following:

2.10.1

With the unit in the Run Mode press the **MODE/STORE** switch.

2.10.2

Press **-/CRSR** when asked to log data.

2.10.3

Press **-/CRSR** to choose the Parameters Mode.

2.10.4

Press **-/CRSR** to step through each display until **ALARM at 0000** is displayed.

2.10.5

The alarm value can be changed by holding down the RESET switch and simultaneously pressing +/-INC to increment the digit above the cursor. The cursor position can be changed by holding down the RESET switch and simultaneously pressing -/CRSR.

2.11 Other Features

These features are accessed in the Parameters Mode.

2.11.1 Auto Logging Selection

The 580B can be configured to automatically log data points. The top line of the display will show:

AUTO LOGGING

The bottom line will alternate between "RESET TO CHG" and "ON" or "OFF". Pressing the RESET switch will cause the 580B to show:

AUTO LOGGING
+/ON -/OFF

Pressing the -/CRSR switch will turn auto logging off and return operation to the previous screen. Pressing the +/-INC switch will enable auto logging and allow setting of the logging interval. The display will show:

INTERVAL 00:01
"RESET" WHEN DONE

The +/-INC switch will increment the number above the cursor and the -/CRSR switch will move the cursor. The logging interval format is MM:SS (where M is minute and S is second). Pressing the RESET switch will return operation to the first auto logging screen.

Note: Auto logging is not allowed in the Max Hold Mode.

2.11.2 Average Time Selection

The 580B can be configured to display the average PPM from once a second up to once every four minutes. The display will show:

AVERAGE = 0:01
"RESET" TO CHG

Pressing the RESET switch will cause the 580B to show:
by Overload error before changing

AVERAGE = 0:01
"RESET" WHEN DONE

The +/-INC switch will increment the number above the cursor and the -/CRSR switch will move the cursor. The average time format is M:SS (where M is minutes and S is seconds).

Note: The maximum averaging interval is four minutes.

2.11.3 Lamp Selection

Note: This unit only contains one lamp. The following procedure is used when lamps of different ionization potential are physically changed inside the unit.

The 580B will display:

LAMP

on the top line. The bottom line will alternate every two seconds between:

"RESET" TO CHG

and the currently selected lamp setting and its associated serial number.

i.e.

11.8 eV 000000

By pressing the RESET switch, the 580B will display:

+/-10 eV +/-11 eV

Choose the desired lamp installed in the unit. Choose +/-10eV for a 10.6 ev lamp.

2.11.4 Response Factor Setting

The current Response Factor setting will displayed on the top line of the display. The Response Factor may be changed by simultaneously pressing the RESET switch with either the +/-INC switch to increment the digit above the cursor or the -/CRSR switch to move the cursor.

The response factor is used to equate the response of one organic vapor with that of the calibration gas. The current reading is always multiplied by the response factor in order to obtain the displayed concentration. A response factor of one will not change the displayed concentration.

Note: In most instances the response factor should be left as one. Contact the Health and Safety Coordinator before changing.

2.11.5 Free Space Indication

This section will give a rough indication of how much room is left for logging data points. The screen will display a bar graph on the top line and the amount of free space on the bottom line. The number indicates the total number of bytes which are available. Each data point takes fifteen bytes. Other bytes may also be needed in order to store other important information. This is why only a rough indication of room may be given.

2.11.6 Clock Mode

The Clock mode is entered from the Main menu by pressing the SPKR switch. The screen will display the date and time on the top line. The bottom line will display:

"RESET" TO CHG

By pressing the RESET switch the 580B will display:

"RESET" WHEN DONE

The date and time may be changed by pressing the +/-INC switch to increment the number (or in the case of the month the months abbreviation) above the cursor. The -/CRSR switch will move the cursor. Once the proper months has been entered the RESET switch should be pressed. The 580B will return to the previous screen.

The date and time will be maintained even when the instrument is turned off. It is however advisable that the date and time periodically be checked to ensure that it is correct.

2.11.7 Communication Mode

The Communication mode is entered from the main menu by pressing the RESET switch. The Communications mode has four sections.

1. Communicate with printer or computer
2. Display logged data
3. Reset logged data
4. Set communication parameters

See the instrument manual for detailed instructions for downloading data or for playing back logged data on the screen.

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[mad-603-52a]
99100.88

3

CALIBRATION

The 580B should be calibrated at the beginning and end of each day and as needed throughout the work day as weather or work conditions change. Use the following procedure.

3.1

Fill the calibration bag with isobutylene from the calibration gas cylinder.

3.2

With the unit warmed up and in the Run Mode press the MODE/STORE switch. The unit will display

LOG THIS VALUE

3.3

Press the -/CRSR switch. The unit will display

R/COMM -/PARAM

+/ACCESS S/CLOCK

3.4

Press -/CRSR to get into the -/PARAM mode.

3.5

Keep stepping through each display by pressing -/CRSR until RESET TO CAL is displayed.

3.6

Press the RESET switch. The unit will display

RESTORE BACKUP + YES

3.7

Press -/CRSR. The unit will display

ZERO GAS RESET WHEN READY

3.8

Place the unit in an area free from organic vapors or alternately attach a calibration bag filled with zero grade air to the sampling probe (see Figure 3).

3.9

Press RESET. The unit will display:

MODEL 580 ZEROING

then:

SPAN PPM = 0000

3.10

Change the span gas concentration by holding down the RESET switch and simultaneously pressing the +/INC switch to increment the digit above the cursor to the desired value. Change the cursor position by holding down the RESET switch and simultaneously pressing the -/CRSR switch.

3.11

Once the desired value is entered press +/INC to continue. The unit will display:

SPAN GAS RESET WHEN READY

3.12

Attach the calibration bag filled with isobutylene calibration gas, to the sampling probe (see Figure 3) and press RESET. The unit will display:

MODEL 580 CALIBRATING

3.13

After the unit has calibrated it will display:

"RESET" TO CALIBRATE

Remove the calibration bag and press the MODE/STORE switch to get back to the Run Mode. Check that the unit is calibrated by reattaching the calibration bag. The unit should read the concentration of isobutylene.

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[mad-603-52b]
99100.88

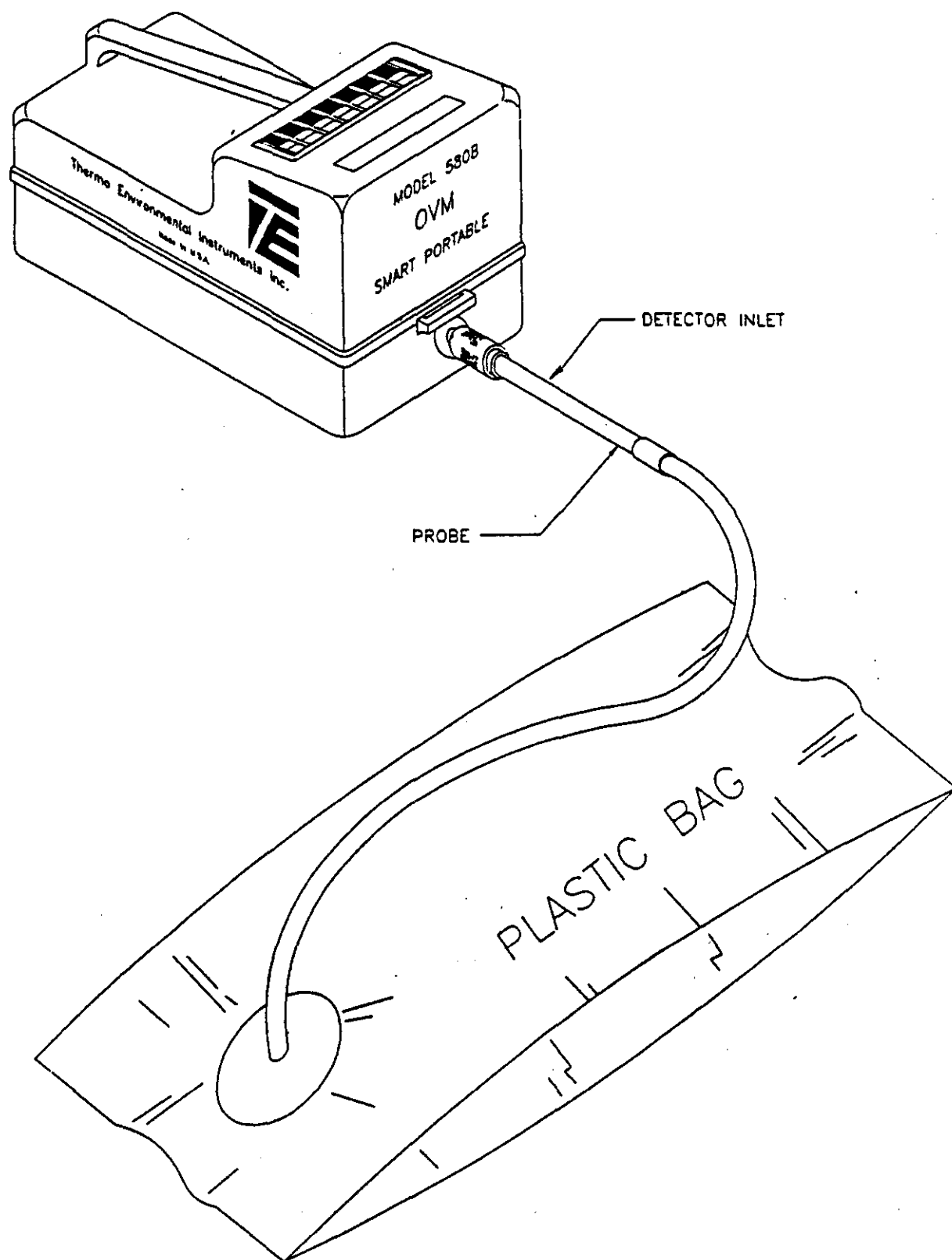


Figure 3
Instrument Calibration

MAINTENANCE

4.1 Battery/Charger

The model 580B uses a 1.2 amp hour lead acid (gel cell) battery. The battery is rechargeable with the charger provided with the instrument. The charger is regulated so that there is no danger of "over charging" the battery. It is suggested that the 580B be charged over the weekend (as well as each evening) during periods of heavy usage in order to ensure maximum battery charge.

4.2 Lamp Insertion and Removal

4.2.1 Removal

Note: The 580B must be off while removing the lamp.

In order to remove the lamp the four screws which hold the case top and bottom together must first be loosened. The case bottom should be placed flat on the table and the top placed on its side next to the bottom.

The high voltage power supply is removed next by loosening the thumb screws on each side and then pulling the power supply towards the rear of the instrument (see Figure 4). The lamp may now be removed by loosening the lamp nut.

4.2.2 Insertion

Insertion of the lamp is accomplished by performing the above tasks in the reverse order. The lamp should be placed flat against the o-ring and the lamp nut fastened down in order to create a proper seal. The high voltage power supply should then be inserted and the thumb screws fastened down. There are three pins protruding from the high voltage power supply which should fit snugly into connectors located beneath the detector. The lamp spring (mounted in the center of the high voltage power supply) should make contact with the lamp ring.

4.2.3 Lamp Cleaning

On occasion the lamp should be removed for cleaning. Cleaning of the lamp is accomplished by cleaning the lens surface of the UV lamp. This is accomplished by using the aluminum oxide scouring powder provided with the 580B.

MATERIAL LIST				
ITEM	PART NO.	DESCRIPTION	QTY	
1	5808-6003	DETECTOR SUB ASSY.	1	
2	5805-2010	NUT - LAMP (13507)	1	
3	5805-6019	PWR. SUPPLY ASSY. (13560)	1	
4	12082	NUT - KNURLED	2	
5	11979	U.V. LAMP 100	1	
6	5805-6035	DETECTOR WIRING ASSY. (13575)	1	
7	5808-6001	BASE HARNESS ASSY.	1	
8	4166	STRAIN RELIEF	1	
9	5805-6028	SIGNAL CABLE (13568)	1	
10	5814	1/4-40 X 1/4" BRDR HD. SCREW	2	
11				
12				
13	5510	TEFLON TUBING 1/8" 6.5' LG	1	
14	5588	1/4 INT. 100TH STAR WASHER	1	
15	4417	UNION-2U-316	1	

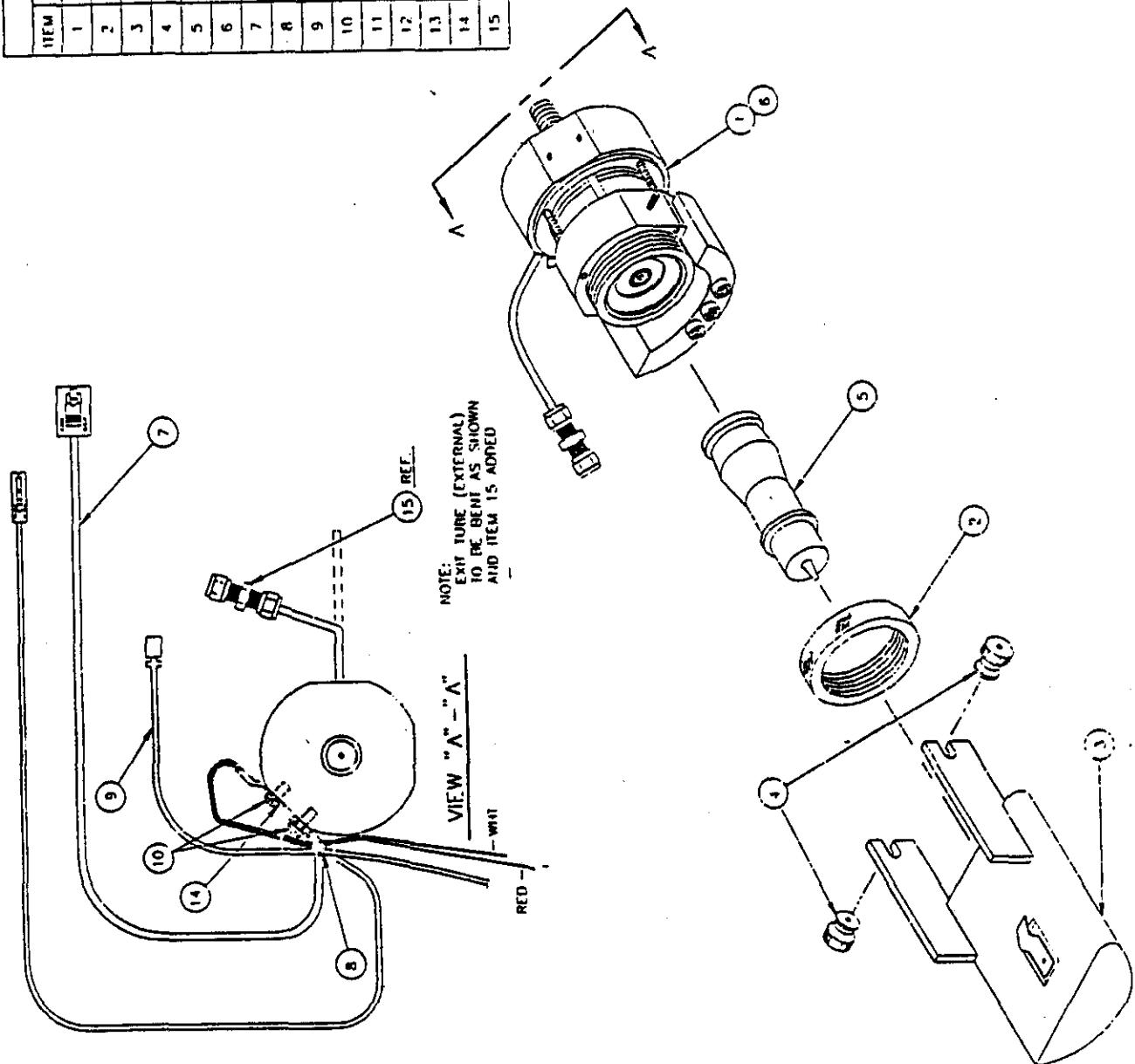


Figure 4
Lamp Insertion and Removal

The procedure for cleaning the lamp is as follows. First place a small amount of aluminum oxide scouring powder on the lens of the UV lamp. Next gently scour this lens with a soft tissue or cloth. Scour the lens in a rotary type motion. After scouring the lens surface, gently blow the remaining powder from the lens. Thoroughly wipe the lamp lens with a clean tissue to remove the last traces of cleaning powder. The lamp is now able to be inserted into the detector.

4.3 Dust Filter

The small porous dust filter in the extension probe can become clogged with dirt. The filter should be cleaned by wiping with a soft cloth or by rinsing with water. The filter must be thoroughly dried before reinstalling on the unit. If the dust filter becomes too dirty it should be replaced.

4.4 Moisture Trap

The water trap assembly (Figure 5) is designed to effectively stop water from entering the instrument. Use a piece of tygon tubing to install the trap to the sample probe. Water traps should be replaced if they become wet.

EAG/vlr/
[mad-603-52c]
99100.88

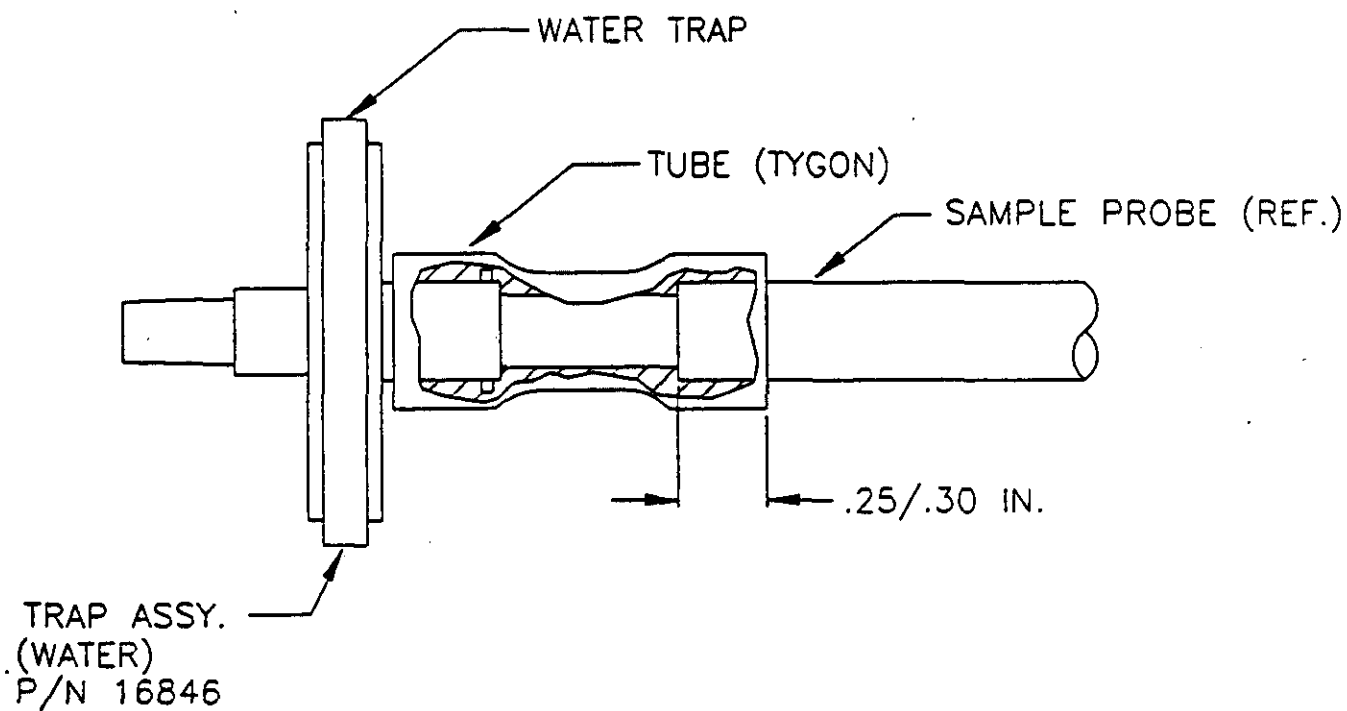


Figure 5
Moisture Trap

L

RESPIRATORY PROTECTION PLAN

L

RESPIRATORY PROTECTION PROGRAM

RESPIRATOR SELECTION AND IDENTIFIED HAZARDS/POTENTIAL HAZARDS

Respirator selection is to be made in accordance with this Section of the Health and Safety Manual, the manufacturer's guidelines and the American National Standards Institute (ANSI) Practices for Respiratory Protection Z88.2-1969.

The decision-logic flow chart found in Section 0500 of the Health and Safety Manual contains recommended guidelines for determining the level of respiratory protection for field sites. Obviously not all conditions which might be encountered are included. Questions concerning which level of respiratory protection to select are to be directed to the office Health and Safety Coordinator.

RESPIRATOR LIMITATIONS

Air-Purifying Respirators

In order to use an air-purifying respirator, the following conditions must be met:

- Oxygen level must be between 19.5 % and 23.5 %.
- Atmospheric contaminants must have good warning properties:
 - Can be recognized by taste or smell
 - Odor/taste threshold must be well below permissible exposure limit (PEL) and threshold limit value (TLV)
- Contaminant is not shock-sensitive or water-reactive.

- A chemical cartridge must be available and approved for use with the known contaminants.
- Air-contaminant level does not exceed the maximum-use concentration (MUC) set by the cartridge manufacturer. While the MUC is specific for each cartridge and is dependent on the type and amount of absorbant, the following MUCs are generally true:
 - 1,000 ppm for organic-vapor cartridges
 - 20,000 ppm for organic-vapor canisters
 - 50 ppm for hydrogen chloride (acid gas) cartridge
 - 50 ppm for sulfur dioxide (acid gas) cartridge
 - 10 ppm for chlorine (acid gas) cartridge

A partial list of gaseous materials for which air-purifying (chemical cartridge) respirators should NOT be used for respiratory protection regardless of concentrations or time of exposures follows. Should concentrations of any of these contaminants be expected to exceed one-half of the TLV, use of an air-supplied respirator would generally be indicated.

Acrolein	Hydrogen selenide	Nitroglycerin
Aniline	Hydrogen sulfide	Nitromethane
Arsine	Methanol	Ozone
Bromine	Methyl bromide	Phosgene
Carbon monoxide	Methyl chloride	Phosphine
Di-isocyanates	Methylene chloride	Phosphorous trichloride
Dimethyl aniline	Nickel carbonyl	Stibine
Dimethyl sulfate	Nitro compounds:	Sulfur chloride
Hydrogen cyanide	-Nitrobenzene	Vinyl chloride
Hydrogen fluoride	-Nitrogen oxides	

Chemical cartridges are to be changed at least at the end of each work shift in addition to whenever breathing becomes difficult or breakthrough (e.g., you can taste or smell the contaminant) occurs.

The primary means of identifying chemical cartridges is the wording of the labels. The secondary means of identification is color coding. The following color coding is used:

- Acid gases: white

- Hydrocyanic acid gas: white with 1/2-inch green stripe completely around the cartridge near the bottom
- Chlorine gas: white with 1/2-inch yellow stripe completely around the cartridge near the bottom
- Organic vapors: black
- Ammonia gas: green
- Carbon dioxide: blue
- Acid gases and organic vapors: yellow
- Hydrocyanic acid gas and chloropicrin vapor: yellow with 1/2-inch blue stripe completely around the cartridge near the bottom
- Acid gases, organic vapors, and ammonia vapors: brown
- Radioactive materials, except tritium and noble gases: purple (magenta)
- Particulates (dust, fumes, mists, fogs or smokes) in combination with any of the above gases or vapors: cartridge color for the contaminant as designated above with 1/2-inch gray stripe completely around the cartridge near the top
- All of the above atmospheric contaminants: red with 1/2-inch gray stripe completely around the cartridge near the top

Air-Supplied Respirators

Air-line respirators and self-contained breathing apparatus (SCBA) are two types of air-supplied respirators (ASR). The breathing air is supplied from either a compressor or a compressed gas cylinder. Supplied-air quality is discussed in separate section which details breathing-air specifications.

Such units are to be operated in the pressure-demand/positive-pressure mode which maintains a slight positive pressure within the facepiece even if a facepiece leak occurs. This prevents contaminants from entering the facepiece.

If an air-line respirator is used in an atmosphere where the level of contaminants is immediately dangerous to life or health (IDLH), an escape bottle with at least a five-minute air supply is to be used with it. An SCBA is to have an alarm that sounds when there is a five-minute supply of air remaining in the tank.

Breathing-air hoses should be kept to less than 200 feet in length for ease of use and breathing; 300 feet lengths are the maximum allowed. Breathing-air hoses are to be dedicated and marked "For Respirator Use Only"; they are not to be used for other applications. The diameter is set by the manufacturer and this size must be used for proper air flow and respirator operation. The respirator manufacturer's hoses must be used to ensure proper operation, maintenance of NIOSH certification and maintenance of respirator manufacturer's product liability.

Air hoses are to be kept off the ground whenever possible and protected from chemical contamination. Do not lay or drag fittings on the ground. Protect air hoses from damage, entanglement, or snagging by heavy equipment, moving machinery, and sharp objects.

RESPIRATOR CARE

Storage

Respirators, when not in use, are to be stored in a clean, dry location, out of direct sunlight. They are to be stored in such a manner that the facepiece, seal, and exhalation valves are not distorted during storage. Do not place objects on top of the respirator during storage.

Inspection

The following inspection points are to be checked prior to donning the respirator and after each use. Under no circumstances should a respirator which fails this inspection be worn. It is to be repaired or replaced.

- Check to see that the headbands still have their elasticity. Inspect for cracks or tears and make sure that all buckles are in place and working properly.
- Check the facepiece for dirt, cracks, tears, or holes. Inspect the shape of the facepiece for distortion that can occur from improper storage and make sure that the face seal is flexible, not stiff.
- Check the inhalation and exhalation valves for cracks, tears, distortions, dirt, build-up of material between the valve and valve seat, and signs of deterioration or degradation.
- For APRs, check the cartridge holders to be sure the gaskets are in place. Check the threads for damage and cracks.

- For APRs, be sure the cartridges and filters are clean. Never try to clean a cartridge or filter by washing it or using compressed air. Inspect the cartridge for dents, scratches or other damage that may effect the seal.
- For ASRs, check the backpack and harness assemblies for damage, worn parts, and proper function. Check the air line and fittings for signs of damage and proper seal.
- For SCBAs, check the cylinder and cylinder valve assembly, regulator, low-air alarm, and high-pressure valve for damage and proper function. Check the breathing tube for cracks, signs of damage, and good seals.

Cleaning

Contaminated respirators are to be cleaned in accordance with the Decontamination SOP first, then regular cleaning is to be completed.

- Break down respirator into its component parts.
- For APRs, discard expended filters and cartridges.
- Discard head straps and valves if they are too contaminated to be cleaned, no longer functional or damaged.
- Wash all remaining parts in warm water and mild detergent. Scrub parts with a soft brush.
- Rinse all parts in clean, warm (120 °F) water.
- Let respirator and its parts air dry in a clean area.
- Inspect all parts and replace if needed. Assemble respirator.
- Wipe all portions of the respirator with antiseptic solution or wipes.
- For APRs, replace used and expended cartridges with the proper new ones.
- Place respirator in plastic bag, seal and store in designated area.

Maintenance

Respirators are to be kept in good condition to function properly. When any part shows evidence of excessive wear or failure, it is to be replaced immediately with

the proper part from the manufacturer. Parts from different makes and models of respirators are not interchangeable.

SUPPLIED AIR QUALITY

When conditions require the use of ASRs, the minimum quality level which can be used is Grade-D breathing air. The specifications for Grade-D breathing air are described in Compressed Gas Association Commodity Specification G-7.1-1966 and are summarized below:

- Hydrocarbons, as methane, ≤ 5 ppm
- Carbon monoxide ≤ 20 ppm
- Carbon dioxide $\leq 1,000$ ppm
- No odor
- Oxygen level = 20.9 % if recompressed air, 19.5 % to 23.5 % if reconstituted air

Compressed oxygen, liquid air or liquid oxygen are not to be used.

Breathing air may be supplied to respirators by compressed-gas cylinders or air compressors.

Compressors that are used to supply breathing air are to be equipped with necessary safety and standby devices. Only breathing-air-type compressors are to be used. Compressors are to be constructed and located so as to avoid the entry of contaminated air into the system (e.g., do not place compressor near operating equipment with combustion engines.). Suitable in-line air-purifying absorbant beds and filters are to be installed to further ensure breathing-air quality. Alarms to indicate compressor failure or over-heating are to be installed.

A compressor is to be used in conjunction with a secondary air receiver, such as an escape cylinder worn by the individual, of sufficient capacity to allow the wearer to escape from the contaminated atmosphere in the event of compressor failure. Compressors can utilize vortex coolers if sufficient air quality and pressure is available (15 to 20 cfm at 70 to 80 psig).

If an oil-lubricated compressor is used, it is to have a high-temperature alarm and a carbon monoxide alarm.

Couplings specific for air lines are to be used. Such couplings are to be incompatible with outlets for other gas systems to prevent unintentional connection to non-respirable gases or oxygen.

USE OF RESPIRATORS

Leave the area, follow decontamination procedures, and see your supervisor if any of the following occur:

- Respirator becomes dislodged.
- An odor, taste, or respiratory or throat irritation occurs.
- Air from respirator gets very warm.

When using self-contained breathing apparatus (SCBA) or when there is the possibility of an oxygen-deficient (<19.5%) atmosphere or toxic contaminants of a level that are immediately dangerous to life or health (IDLH), in addition to the employees performing the task, there is to be an attendant. This attendant is to maintain communications - visual, audio, or signal line - with all employees working in the Exclusion Zone. The attendant is to remain outside the Exclusion Zone, in a area where it is unlikely that the attendant will be effected by an incident in the Exclusion Zone. The attendant is to have immediately available the necessary rescue equipment to assist the other employees in case of an emergency. Such rescue equipment is not limited to respiratory protection but may include such items as safety lines, harnesses, hoists, and radio communications.

Employees wearing ASRs are to also wear safety harnesses and safety lines to aid in lifting or removing them from hazardous atmospheres.

An employee is not to be allowed to wear a respirator if any conditions exist which prevent a good face seal. Such conditions include beard, sideburns, or other facial hair that projects under the facepiece, and temple pieces on glasses. The absence of one or both dentures may also adversely affect the facepiece seal.

Each employee who might be expected to wear a respirator in the course of performing assigned work tasks is to be qualitatively fit tested at least annually using at least two different test atmospheres. Generally isoamyl acetate (banana oil) and irritant smoke are used. Employees are to check the fit of their facepiece, using the positive- and negative-pressure tests, each time they don the respirator and also prior to entering a contaminated atmosphere.

Those employees wearing corrective lenses are to not wear any style which interferes with the face-to-facepiece seal of the respirator. Examples of appropriate corrective lenses to wear with respirators include glasses with the side-temple pieces removed and optical inserts specifically made for the respirator. Should an employee require optical inserts, such inserts will be supplied by Warzyn.

M

CHEMICAL HAZARD SUMMARY SHEETS

CHEMTOX DATA

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----- IDENTIFIERS -----

CHEMTOX RECORD 84

LAST UPDATE OF THIS RECORD: 06/03/93

NAME: CADMIUM
SYNONYMS: NONE
CAS: 7440-43-9
FORMULA: Cd
WLN: .CD
CHEMICAL CLASS: Metal

RTECS: EU9800000
MOL WT: 112.40

See other identifiers listed below under Regulations.

----- PROPERTIES -----

PHYSICAL DESCRIPTION: soft, blue-white, malleable, lustrous metal;
grayish-white powder

BOILING POINT:	1040 K	766.8 C	1412.3 F
MELTING POINT:	593.9 K	320.7 C	609.3 F
FLASH POINT:	NA		
AUTO IGNITION:	NA		
VAPOR PRESSURE:			
JEL:	NA		
LEL:	NA		
VAPOR DENSITY:	No data		
SPECIFIC GRAVITY:	8.64		
DENSITY:	8.64		
WATER SOLUBILITY:	insoluble		
INCOMPATIBILITIES:	strong ox, elemental sulfur, selenium, tellurium		

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS: No data
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: oxides of cadmium
ODOR DETECTED AT (ppm): Unknown
ODOR DESCRIPTION: No data
100 % ODOR DETECTION: No data

----- REGULATIONS -----

DOT hazard class: 9 CLASS 9
DOT guide: 31
Identification number: UN3077
DOT shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCES, SOLID,
N.O.S. (CADMIUM)
Packing group: III

bel(s) required: CLASS 9
ecial provisions: 8, B54
ckaging exceptions: 173.155
n bulk packaging: 173.213
lk packaging: 173.240
antity limitations-
ssenger air/rail: NONE
rgo aircraft only: NONE
ssel stowage: A
her stowage provisions:

CC NUMBER: Not listed

LEAN WATER ACT Sect.307:Yes

LEAN WATER ACT Sect.311:No

tional Primary Drinking Water Regulations

Maximum Contaminant Levels (MCL): 0.005 mg/L (07/30/92)

Maximum Contaminant Level Goals (MCLG): 0.005 mg/L (07/30/92)

LEAN AIR ACT: CAA '90 By category

A WASTE NUMBER: D006

RCLA REF: Y

DESIGNATION: A 10 pounds (4.54 kg) CERCLA for pieces of solid me
with diameter less than 100 micrometers (0.004
inches).

RA TPQ VALUE: Not listed

RA Sect. 312
categories:

Acute toxicity: adverse effect to target organs.

Chronic toxicity: carcinogen

Chronic toxicity: adverse effect to target organ
after long period of exposure.

Chronic toxicity: mutagen.

Chronic toxicity: reproductive toxin.

Fire hazard: flammable.

Acute toxicity: Toxic. LD50 > 50 and <= 500
mg/kg (oral rat).

STED IN SARA Sect 313: Yes

minus CONCENTRATION: 0.1 percent

ITED STATED POSTAL SERVICE MAILABILITY:
t given

PA CODES:

HEALTH HAZARD (BLUE): Unspecified

FLAMMABILITY (RED) : Unspecified

REACTIVITY (YELLOW): Unspecified

SPECIAL : Unspecified

----- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON -----

ACGIH TLV list "Threshold Limit Values for 1989-1990"
 ATSDR Toxicology Profile available (NTIS** PB/89/194476)
 CADMIUM [7440-43-9]
 California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
 California Assembly Bill 1807 Toxic Air Contaminants.
 California Proposition 65 Carcinogen List
 Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
 Clean Air Act of November 15, 1990. List of pollutants.
 Clean Water Act Section 307 Priority Pollutants
 DOT Marine Pollutant. Proposed list. 57 FR 3854, Jan 31, 1992
 EPA Carcinogen Assessment Group List
 EPA TSCA Chemical Inventory List 1986
 EPA TSCA Chemical Inventory List 1989
 EPA TSCA Chemical Inventory List 1990
 EPA TSCA Chemical Inventory List 1992
 EPA TSCA Test Submission (TSCATS) Database - April 1990
 EPA TSCA Test Submission (TSCATS) Database - September 1989
 Massachusetts Substance List.
 National Toxicology Program list of anticipated human carcinogens
 New Jersey DEQ100 list for release reporting.
 New Jersey Right To Know Substance List. (December 1987)
 New Jersey Right to Know Substance List. Listed as a carcinogen.
 OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
 Pennsylvania Hazardous Substance List
 RCRA Hazardous Waste
 RCRA Toxicity Characteristics (TC) list dated March 29, 1990
 SARA Section 313 Toxic Chemicals List
 Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

----- TOXICITY DATA -----

SHORT TERM TOXICITY: Unknown

LONG TERM TOXICITY: unknown

TARGET ORGANS: resp sys, lungs, kidneys, prostate, blood

SYMPTOMS: PULM EDEMA, CYPS, COUGH, TIGHT CHEST, SUBS PAIN; HEAD,
 CHILLS, MUSCLE ACHE; NAU, DIAR ANOSMIA, EMPHY;
 PROTEINURIA, ANEMIA Source: NIOSHP

CONC IDLH: 50mg/M3asdust, 9mg/M3asfume

NIOSH REL: Potential occupational carcinogen --LOWEST FEASIBLE
 (LOQ 0.01 mg/M3)

ACGIH TLV: TLV = DUST 0.05mg/M3 as CADMIUM
 ACGIH STEL: as CADMIUM

OSHA PEL: Final Rule Limits:
 TWA = 5 ug/M3
 Consult 29CFR 1910.1027

K INFORMATION: Carcinogenic working material without MAK
In the Commission's view, an animal carcinogen.

RCINOGEN?: Y STATUS: See below
FERENCES:

ANIMAL POSITIVE IARC** 2,74,73
ANIMAL POSITIVE IARC** 11,39,76

RCINOGEN LISTS:

IARC: Carcinogen defined by IARC
to be probably carcinogenic to
humans with (usually) at least
limited human evidence.
MAK: An animal carcinogen.
NIOSH: Carcinogen defined by NIOSH
with no further categorization.
NTP: Carcinogen defined by NTP as
reasonably anticipated to be
carcinogenic, with limited
evidence in humans or sufficient
evidence in experimental animals.
ACGIH: Not listed
OSHA: Cancer hazard

MAN TOXICITY DATA: (Source: NIOSH RTECS)
ihl-man TCLO:88 ug/m3/8.6Y AEHLAU 28,147,74
KIDNEY, URETER, BLADDER
Proteinuria

ihl-hmn LCLo:39 mg/m3/20M AIHAAP 31,180,70
CARDIAC
Other changes
VASCULAR
Thrombosis distant from injection
site(except brain, heart)
LUNGS, THORAX, OR RESPIRATION
Respiratory depression

50 value: orl-rat LD50:225 mg/ kg

HER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:225 mg/kg
ihl-rat LC50:25 mg/m3/30M
ipr-rat LD50:4 mg/kg
scu-rat LD50:9 mg/kg
ivn-rat LD50:1800 ug/kg
unr-rat LD50:1140 mg/kg
orl-mus LD50:890 mg/kg
ihl-mus LCLo:170 mg/m3
ipr-mus LD50:5700 ug/kg
unr-mus LD50:890 mg/kg

orl-rbt LDLo:70 mg/kg
scu-rbt LDLo:6 mg/kg
ivn-rbt LDLo:5 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):

This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

orl-rat TDLo:155 mg/kg (13W male/13W pre-3W preg)
BECTA6 20,96,78

EFFECTS ON NEWBORN

Growth statistics(e.g.,reduced weight gain)

EFFECTS ON NEWBORN

Behavioral

orl-rat TDLo:220 mg/kg (1-22D preg) TOLED5 11,233,82

EFFECTS ON EMBRYO OR FETUS

Other effects on embryo or fetus

orl-rat TDLo:21500 ug/kg (multigenerations) ENVRAL
22,466,80

EFFECTS ON FERTILITY

Pre-implantation mortility

EFFECTS ON NEWBORN

Germ cell effects(in offspring)

orl-rat TDLo:23 mg/kg (1-22D preg) PSEBAA 158,614,78

SPECIFIC DEVELOPMENTAL ABNORMALITIES

Blood and lymphatic systems(including spleen and
marrow)

ipr-rat TDLo:1124 ug/kg (1D male) TXAPA9 41,194,77

PATERNAL EFFECTS

Spermatogenesis

scu-rat TDLo:250 ug/kg (19D preg) APTOD9 19,A122,80

EFFECTS ON NEWBORN

ivn-rat TDLo:1250 ug/kg (14D preg) JJATDK 1,264,81

SPECIFIC DEVELOPMENTAL ABNORMALITIES

Body wall

SPECIFIC DEVELOPMENTAL ABNORMALITIES

Urogenital system

ivn-rat TDLo:1250 ug/kg (9D preg) JJATDK 1,264,81

SPECIFIC DEVELOPMENTAL ABNORMALITIES

Central nervous system

SPECIFIC DEVELOPMENTAL ABNORMALITIES

Eye,ear

ivn-rat TDLo:8 mg/kg (8-15D preg) JJATDK 1,264,81
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

orl-mus TDLo:448 mg/kg (multigenerations) AEHLAU
23,102,71
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
EFFECTS ON EMBRYO OR FETUS
Fetal death

orl-mus TDLo:1700 mg/kg (8-12D preg) TCMUD8 6,361,86
EFFECTS ON NEWBORN
Viability index(# alive at day 4 per # born alive)
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)

ipr-mus TDLo:1686 ug/kg (7D preg) TJADAB 28,39A,83
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Central nervous system

----- EPA's IRIS DATA SUMMARY -----
dmium; CASRN 7440-43-9 (04/01/92)

I. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

stance Name -- Cadmium
SRN -- 7440-43-9
st Revised -- 03/01/91

ction II provides information on three aspects of the carcinogenic risk
essment for the agent in question; the U.S. EPA classification, and quant-
ative estimates of risk from oral exposure and from inhalation exposure.
e classification reflects a weight-of-evidence judgment of the likelihood
at the agent is a human carcinogen. The quantitative risk estimates are
esented in three ways. The slope factor is the result of application of a
w-dose extrapolation procedure and is presented as the risk per (mg/kg)/day.
e unit risk is the quantitative estimate in terms of either risk per ug/L
inking water or risk per ug/cu.m air breathed. The third form in which risk
presented is a drinking water or air concentration providing cancer risks
1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2
ervice Code 5) provides details on the rationale and methods used to derive
e carcinogenicity values found in IRIS. Users are referred to Section I for
formation on long-term toxic effects other than carcinogenicity.

II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

_II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- B1; probable human carcinogen

Basis -- Limited evidence from occupational epidemiologic studies of cadmium is consistent across investigators and study populations. There is sufficient evidence of carcinogenicity in rats and mice by inhalation and intramuscular and subcutaneous injection. Seven studies in rats and mice wherein cadmium salts (acetate, sulfate, chloride) were administered orally have shown no evidence of carcinogenic response.

II.A.2. HUMAN CARCINOGENICITY DATA

Limited. A 2-fold excess risk of lung cancer was observed in cadmium smelter workers. The cohort consisted of 602 white males who had been employed in production work a minimum of 6 months during the years 1940-1969. The population was followed to the end of 1978. Urine cadmium data available for 261 workers employed after 1960 suggested a highly exposed population. The authors were able to ascertain that the increased lung cancer risk was probably not due to the presence of arsenic or to smoking (Thun et al., 1985). An evaluation by the Carcinogen Assessment Group of these possible confounding factors has indicated that the assumptions and methods used in accounting for them may not be valid. As the SMRs observed were low and there is a lack of clear cut evidence of a causal relationship of the cadmium exposure only, this study is considered to supply only limited evidence of human carcinogenicity.

An excess lung cancer risk was also observed in three other studies which were, however, compromised by the presence of other carcinogens (arsenic, smoking) in the exposure or by a small population (Varner, 1983; Sorahan and Waterhouse, 1983; Armstrong and Kazantzis, 1983).

Four studies of workers exposed to cadmium dust or fumes provided evidence of a statistically significant positive association with prostate cancer (Kipling and Waterhouse, 1967; Lemen et al., 1976; Holden, 1980; Sorahan and Waterhouse, 1983), but the total number of cases was small in each study. The Thun et al. (1985) study is an update of an earlier study (Lemen et al., 1976) and does not show excess prostate cancer risk in these workers. Studies of human ingestion of cadmium are inadequate to assess carcinogenicity.

II.A.3. ANIMAL CARCINOGENICITY DATA

Exposure of Wistar rats to cadmium as cadmium chloride at concentrations of 12.5, 25 and 50 ug/cu.m for 18 months, with an additional 13-month observation period, resulted in significant increases in lung tumors (Takenaka et al., 1983). Intratracheal instillation of cadmium oxide did not produce lung tumors in Fischer 344 rats but rather mammary tumors in females and tumors at multiple sites in males (Sanders and Mahaffey, 1984). Injection site tumors and distant site tumors (for example, testicular) have been reported by a number of authors as a consequence of intramuscular or subcutaneous administration of cadmium metal and chloride, sulfate, oxide and sulfide compounds of cadmium to rats and mice (U.S. EPA, 1985). Seven studies in rats

1 mice where cadmium salts (acetate, sulfate, chloride) were administered orally have shown no evidence of a carcinogenic response.

II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

Results of mutagenicity tests in bacteria and yeast have been inconclusive. Positive responses have been obtained in mutation assays in Chinese hamster cells (Dom and V79 lines) and in mouse lymphoma cells (Casto, 1976; Shi and Ohsawa, 1983; Oberly et al., 1982).

Conflicting results have been obtained in assays of chromosomal aberrations in human lymphocytes treated in vitro or obtained from exposed workers. Cadmium treatment in vivo or in vitro appears to interfere with spindle formation and to result in aneuploidy in germ cells of mice and hamsters (Mimada et al., 1976; Watanabe et al., 1979; Gilliavod and Leonard, 1975).

II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available. There are no positive studies of orally ingested cadmium available for quantitation.

II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

II.C.1. SUMMARY OF RISK ESTIMATES

Inhalation Unit Risk -- $1.8E-3$ per (ug/cu.m)

Extrapolation Method -- Two stage; only first affected by exposure; extra risk

for Concentrations at Specified Risk Levels:

Risk Level	Concentration
-----	-----
E-4 (1 in 10,000)	$6E-2$ ug/cu.m
E-5 (1 in 100,000)	$6E-3$ ug/cu.m
E-6 (1 in 1,000,000)	$6E-4$ ug/cu.m

II.C.2. DOSE-RESPONSE DATA FOR CARCINOGENICITY, INHALATION EXPOSURE

Major Type -- lung, trachea, bronchus cancer deaths

Test Animals -- human/white male
 Route -- inhalation, exposure in the workplace
 Reference -- Thun et al., 1985

Cumulative Exposure (mg/day/cu.m)	Median Observation	24 hour/ ug/cu.m Equivalent	No. of Expected Lung, Trachea and Bronchus Cancers Assuming No Cadmium Effect	Observed No. of Deaths (lung, trachea, bronchus cancers)
less than or equal to 584	280	168	3.77	2
585-2920	1210	727	4.61	7
greater than or equal to 2921	4200	2522	2.50	7

24-hour equivalent = median observation x $10E-3$ x $8/24$ x $1/365$ x $240/365$.

II.C.3. ADDITIONAL COMMENTS (CARCINOGENICITY, INHALATION EXPOSURE)

The unit risk should not be used if the air concentration exceeds 6 ug/cu.m, since above this concentration the unit risk may not be appropriate.

II.C.4. DISCUSSION OF CONFIDENCE (CARCINOGENICITY, INHALATION EXPOSURE)

The data were derived from a relatively large cohort. Effects of arsenic and smoking were accounted for in the quantitative analysis for cadmium effects.

An inhalation unit risk for cadmium based on the Takenaka et al. (1983) analysis is $9.2E-2$ per (ug/cu.m). While this estimate is higher than that derived from human data [$1.8E-3$ per (ug/cu.m)] and thus more conservative, it was felt that the use of available human data was more reliable because of species variations in response and the type of exposure (cadmium salt vs. cadmium fume and cadmium oxide).

II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

II.D.1. EPA DOCUMENTATION

S. EPA. 1985. Updated Mutagenicity and Carcinogenicity Assessment of Cadmium: Addendum to the Health Assessment Document for Cadmium (May 1981, A 600/B-B1-023). EPA 600/B-83-025F.

II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The Addendum to the Cadmium Health Assessment has received both Agency external review.

Agency Work Group Review: 11/12/86

Verification Date: 11/12/86

II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

William E. Pepelko / ORD -- (202)260-5904 / FTS 260-5904

David Bayliss / ORD -- (202)260-5726 / FTS 260-5726

----- PROTECTION AND FIRST AID -----

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

WEAR EYE PROTECTION TO PREVENT:

EXPOSED PERSONNEL SHOULD WASH:

At the end of each work shift when there was a reasonable probability of contact

WORK CLOTHING SHOULD BE CHANGED DAILY:

If there is any possibility that the clothing may be contaminated.

THE FOLLOWING EQUIPMENT SHOULD BE MADE AVAILABLE:

Eyewash.

REFERENCE: NIOSH

COMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
HA (CADMIUM)

10 ug/M3 or less: Half mask, air purifying respirator equipped with a
PA filter.

5 ug/M3 or less: A powered air purifying respirator (PAPR) with a

loose-fitting hood or helmet equipped with a HEPA filter, or a supplied air respirator with a loose-fitting hood or helmet facepiece operated in the continuous flow mode.

250 ug/M3 or less: A full facepiece air-purifying respirator equipped with a HEPA filter, or a powered air-purifying respirator with a tight-fitting half-mask equipped with a HEPA filter, or a supplied-air respirator with a tight-fitting half mask operated in the continuous flow mode.

250 ug/M3 or less: A powered air-purifying respirator with a tight fitting full facepiece equipped with a HEPA filter, or a supplied air respirator with a tight-fitting full facepiece operated in the continuous flow mode.

5000 ug/M3 or less: A supplied air respirator with half-mask or full facepiece operated in the pressure demand or other positive pressure mode.

Greater than 5000 ug/M3 or unknown concentration: A self-contained breathing apparatus with a full facepiece operated in the pressure demand or other positive pressure mode, or a supplied-air respirator with a full facepiece operated in the pressure demand or other positive pressure mode and equipped with an auxiliary escape type self-contained breathing apparatus operated in the pressure demand mode.

EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode.

FIRST AID SOURCE: NIOSH

EYE: irr immed

SKIN: soap wash

INHALATION: art resp

INGESTION: water, vomit

FIRST AID SOURCE: DOT Emergency Response Guide 1990.

In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

----- INITIAL INCIDENT RESPONSE -----

Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).

DOT SHIPPING NAME: ENVIRONMENTALLY HAZARDOUS SUBSTANCES, SOLID, N.O.S. (CADMIUM

DOT ID NUMBER: UN3077

ERG90

GUIDE 31

* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION

Some of these materials may burn, but none of them ignites readily.

*HEALTH HAZARDS

Contact may cause burns to skin and eyes.

Fire may produce irritating or poisonous gases.

Runoff from fire control or dilution water may cause pollution.

*** EMERGENCY ACTION ***

Keep unnecessary people away; isolate hazard area and deny entry.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.

IRE

Small Fires: Dry chemical, CO₂, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Do not scatter spilled material with high-pressure water streams.
Dike fire-control water for later disposal.

PILL OR LEAK

Stop leak if you can do it without risk.
Small Dry Spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.
Cover powder spill with plastic sheet or tarp to minimize spreading.

IRST AID

In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.
Remove and isolate contaminated clothing and shoes at the site.

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CHEMTOX DATA

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----- IDENTIFIERS -----

CHEMTOX RECORD 167

LAST UPDATE OF THIS RECORD: 06/03/93

NAME: 1,2-DICHLOROETHYLENE
SYNONYMS: ACETYLENE DICHLORIDE; 1,2-DICHLOR-AETHEN (German);
DICHLORO-1,2-ETHYLENE (French); sym-DICHLOROETHYLENE;
1,2-DICHLOROETHYLENE; DIOFORM; NCI-C56031; CIS-ACETYLENE
DICHLORIDE; TRANS-ACETYLENE DICHLORIDE;
SYS-DICHLOROETHYLENE; 1,2-DICHLOROETHENE
CAS: 540-59-0 RTECS: KV9360000
FORMULA: C2H2Cl2 MOL WT: 96.94
WLN: G1U1G
CHEMICAL CLASS: Halogenated h-carbon

See other identifiers listed below under Regulations.

----- PROPERTIES -----

PHYSICAL DESCRIPTION: colorless liquid with an ether-like, slightly acrid
odor, like chloroform

BOILING POINT:	113 K	-160.2 C	-256.3 F
MELTING POINT:	255.38 K	-17.8 C	0 F
FLASH POINT:	275 K	1.85 C	35.3 F
AUTO IGNITION:	733.15 K	460 C	1351.6 F

VAPOR PRESSURE: 180 MM

REL: 12.8 %

LEL: 9.7 %

IONIZATION POTENTIAL (eV): 9.65

VAPOR DENSITY: 3.34 (air=1)

SPECIFIC GRAVITY: No data

DENSITY: 1.28g/mL

WATER SOLUBILITY: 0.35 TO 0.63%

INCOMPATIBILITIES: strong oxidizers, nitrogen dioxide,
solid caustic alkalies or their
concentrated solutions;
difluoromethylene,
dehydrofluoritei

REACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: GRADUALLY DECOMPOSES BY AIR, LIGHT, AND
MOISTURE, FORMING HYDROGEN CHLORIDE
Source: MI

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: WILL NOT OCCUR UNDER NORMAL SHIPPING
CONDITIONS. REACTION NOT VIGOROUS.TOXIC FIRE GASES: None reported other than possible
unburned vapors

OR DETECTED AT (ppm): 0.085 PPM
OR DESCRIPTION: PLEASANT, ETHER-LIKE Source:NYDH
O % ODOR DETECTION: No data

----- REGULATIONS -----

1 hazard class: 3 FLAMMABLE LIQUID
1 guide: 29
entification number: UN1150
1 shipping name: DICHLOROETHYLENE
cking group: II
bel(s) required: FLAMMABLE LIQUID
ecial provisions: T14
ckaging exceptions: 173.150
n bulk packaging: 173.202
lk packaging: 173.242
antity limitations-
ssenger air/rail: 5 L
rgo aircraft only: 60 L
ssel stowage: 1
her stowage provisions:

CC NUMBER: 4909145

EAN WATER ACT Sect.307:No
EAN WATER ACT Sect.311:No
EAN AIR ACT: Not listed
A WASTE NUMBER: D001
RCLA REF: Y
DESIGNATION: Not listed
RA TPQ VALUE: Not listed
RA Sect. 312
categories:

Acute toxicity: Irritant
Acute toxicity: adverse effect to target organs.
Reactive hazard: unstable/reactive.
Fire hazard: flammable.

STED IN SARA Sect 313: Yes
minusus CONCENTRATION: 1.0 percent

ITED STATED POSTAL SERVICE MAILABILITY:
zard class: Flammable liquid - Mailable as ORM-D
ilability: Domestic surface mail only
x per parcel: 1 QT METAL; 1 PT OTHER

PA CODES:

HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with
self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all
temperature conditions.
REACTIVITY (YELLOW): (2) Normally unstable and readily undergoes violent
change, but does not detonate.

SPECIAL : Unspecified

----- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON -----

1,2-DICHLOROETHYLENE [540-59-0]
ACGIH TLV list "Threshold Limit Values for 1989-1990"
California Assembly Bill 1803 Well Monitoring Chemicals.
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
DOT Hazardous Materials Table. 49 CFR 172.101
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
New Jersey Right To Know Substance List. (December 1987)
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
Pennsylvania Hazardous Substance List
RCRA Hazardous Waste
SARA Section 313 Toxic Chemicals List
Washington State Discarded Chemical Products List, November 17, 1989
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

----- TOXICITY DATA -----

SHORT TERM TOXICITY: INHALATION: may cause dizziness, drowsiness, nausea, vomiting, weakness, tremors, cramps, and at high levels unconsciousness. SKIN: may cause irritation. Eyes: may cause irritation. INGESTION: no reports of human ingestion, but may contribute to symptoms listed under inhalation. (NYDH)

LONG TERM TOXICITY: may cause dizziness, drowsiness, nausea, vomiting, weakness and inflammation of the lungs. this substance has produced kidney and liver injury at high levels in laboratory animals. whether it does so in humans is not known. (NYDH)

TARGET ORGANS: resp sys, eyes, CNS

SYMPTOMS: Inhalation causes nausea, vomiting, weakness, tremor, epigastric cramps, central nervous depression. Contact with liquid causes irritation of eyes and (on prolonged contact) skin. Ingestion causes slight depression to deep narcosis. Source: CHRIS

CONC IDLH: 4000PPM

NIOSH REL:

ACGIH TLV: TLV = 200ppm(790 mg/M3)

GIH STEL: STEL = 250 ppm(1,000 mg/M3)

HA PEL: Transitional Limits:
PEL = 200 ppm(790mg/M3)
Final Rule Limits:
TWA = 200 ppm (790 mg/M3)

K INFORMATION: 200 ppm
790 mG/M3
Substance with systemic effects, onset of effect less than or equal to 2 hrs: Peak = 2xMAK for 30 minutes, 4 times per shift of 8 hours.
Danger of cutaneous absorption
Carcinogenic working material without MAK

RCINOGEN?: N STATUS: See below

RCINOGEN LISTS:
IARC: Not listed
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

50 value: orl-rat LD50:770 mg/ kg

HER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:770 mg/kg
ipr-mus LD50:2 gm/kg
ihl-frg LCLO:117 mg/m3/1H

RITATION DATA: (Source: NIOSH RTECS 1992)

productive toxicity (1992 RTECS):

This chemical has no known mammalian reproductive toxicity.

PRODUCTIVE TOXICITY DATA (1992 RTECS)

----- PROTECTION AND FIRST AID -----

ROTECTION SUGGESTED

OM THE CHRIS MANUAL:

ubber gloves; safety goggles; air supply mask or self-contained
eathing apparatus.

OSH POCKET GUIDE TO CHEMICAL HAZARDS:

WEAR APPROPRIATE EQUIPMENT TO PREVENT:

Repeated or prolonged skin contact.

**** WEAR EYE PROTECTION TO PREVENT:**

Reasonable probability of eye contact.

**** EXPOSED PERSONNEL SHOULD WASH:**

Promptly when skin becomes wet.

**** REMOVE CLOTHING:**

Immediately remove any clothing that becomes wet to avoid any flammability

**** REFERENCE: NIOSH**

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)

OSHA (1,2-DICHLOROETHYLENE)

1000 ppm: Any powered air-purifying respirator with organic vapor cartridge(s). * Substance causes eye irritation or damage; eye protection needed. / Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s).

4000 ppm: Any supplied-air respirator operated in a continuous flow mode. * Substance causes eye irritation or damage; eye protection needed.

Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any self-contained breathing apparatus with a full facepiece. / Any supplied-air respirator with a full facepiece.

EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.:

Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: CHRIS Manual 1991

INHALATION: remove from further exposure; if breathing is difficult, give oxygen; if victim is not breathing, give artificial respiration, preferably mouth-to-mouth; give oxygen when breathing is resumed; call a physician.

EYES: flush with water for at least 15 min.

SKIN: wash well with soap and water.

INGESTION: give gastric lavage and cathartics.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes. Remove and isolate contaminated clothing and shoes at the site. Keep victim quiet and maintain normal body temperature.

----- INITIAL INCIDENT RESPONSE -----

RE EXTINGUISHMENT: Dry chemical, foam, carbon dioxide. Note: Water may be ineffective. CHRIS91

Department of Transportation Guide to Hazardous Materials Transport
formation - Publication DOT 5800.5 (1990).

T SHIPPING NAME: DICHLOROETHYLENE

T ID NUMBER: UN1150

G90

GUIDE 29

* POTENTIAL HAZARDS *

FIRE OR EXPLOSION

Flammable/combustible material; may be ignited by heat, sparks or flames.

Vapors may travel to a source of ignition and flash back.

Container may explode in heat of fire.

Vapor explosion hazard indoors, outdoors or in sewers.

Runoff to sewer may create fire or explosion hazard.

HEALTH HAZARDS

May be poisonous if inhaled.

Contact may cause burns to skin and eyes.

Fire may produce irritating or poisonous gases.

Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.

Stay upwind; keep out of low areas.

Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.

Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire.

CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.

FIRE

Some of these materials may react violently with water.

Small Fires: Dry chemical, CO₂, water spray or regular foam.

Large Fires: Water spray, fog or regular foam.

Move container from fire area if you can do it without risk.

Do not get water inside container.

Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.

Withdraw immediately in case of rising sound from venting safety device or or any discoloration of tank due to fire.

PILL OR LEAK

Shut off ignition sources; no flares, smoking or flames in hazard area.

Do not touch or walk through spilled material; stop leak if you can do it without risk.

Use water spray to reduce vapor; do not get water inside container.

Small Spills: Take up with sand, or other noncombustible absorbent material and place into containers for later disposal.

Large Spills: Dike far ahead of spill for later disposal.

FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.

In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes.

Remove and isolate contaminated clothing and shoes at the site.

Keep victim quiet and maintain normal body temperature.

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CHEMTOX DATA

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----- IDENTIFIERS -----

CHEMTOX RECORD 239

LAST UPDATE OF THIS RECORD: 06/03/93

NAME: HYDROGEN SULFIDE
SYNONYMS: ACIDE SULFHYDRIQUE (French); HYDROGENE SULFURE (French);
HYDROGEN SULFIDE (DOT); IDROGENO SOLFORATO (Italian);
SCHWEFELWASSERSTOFF (German); SIARKOWODOR (Polish); STINK
DAMP; SULFURETED HYDROGEN; SULFUR HYDRIDE; ZWAVELWATERSTOF
(Dutch); SULFURETTED HYDROGEN; HYDROSULFURIC ACID; HEPATIC
GAS; HYDROSULFURIC ACID (HYDROGEN SULFIDE)
CAS: 7783-06-4 RTECS: MX1225000
FORMULA: H2S MOL WT: 34
MLN: H2 S
CHEMICAL CLASS: Non-oxidizing min. acid

See other identifiers listed below under Regulations.

----- PROPERTIES -----

PHYSICAL DESCRIPTION: colorless liquefied compressed gas with a rotten egg
odor, but odorless at poisonous concentrations.

BOILING POINT:	213.16 K	-60 C	-76 F
MELTING POINT:	190.38 K	-82.8 C	-117 F
FLASH POINT:	NA		
AUTO IGNITION:	533 K	259.8 C	991.4 F
VAPOR PRESSURE:	20 ATM		
GEL:	46 %		
LEL:	4.3 %		
IONIZATION POTENTIAL (eV):	10.43		
VAPOR DENSITY:	1.189 (air=1)		
SPECIFIC GRAVITY:	No data		
DENSITY:	1.539 g/L @ 0 C		
WATER SOLUBILITY:	2.9%		
COMPATIBILITIES:	strong oxidizers		

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS: No data
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: OXIDES OF SULFUR
ODOR DETECTED AT (ppm): 0.02 PPM
ODOR DESCRIPTION: SIMILAR TO ROTTEN EGGS AT
CONCENTRATIONS BELOW 30 PPM; FROM
30-100 PPM SICKENINGLY SWEET; MANY
PEOPLE RAPIDLY LOSE THE ABILITY TO
DETECT THE SMELL SO ODOR IS NOT A GOOD
WARNING OF EXCESS LEVELS Source: NYDH

0 % ODOR DETECTION:

No data

----- REGULATIONS -----

T hazard class: 2.3 POISON GAS
T guide: 13
Identification number: UN1053
T shipping name: Hydrogen sulfide, liquefied
Shipping group:
Label(s) required: POISON GAS, FLAMMABLE GAS
Special provisions: 2, B9, B13, B14, B31, B73
Packaging exceptions: 173. None
In bulk packaging: 173.304
In bulk packaging: 173.244
Quantity limitations-
Passenger air/rail: Forbidden
Cargo aircraft only: Forbidden
Special stowage: D
Other stowage provisions: 40

ACC NUMBER: 4905410

NEAN WATER ACT Sect.307: No

NEAN WATER ACT Sect.311: No

NEAN AIR ACT: CAA '90 Listed

HA WASTE NUMBER: U135, D001

CERCLA REF: Y

DESIGNATION: B 100 pounds (45.4 kg) CERCLA

RA TPQ VALUE: 500 pounds

RA Sect. 312

categories:

Acute toxicity: adverse effect to target organs.
Chronic toxicity: reproductive toxin.
Fire hazard: flammable.
Sudden pressure: compressed gases.
Acute toxicity: Toxic. LD50 > 50 and <= 500
mg/kg (oral rat).

UNITED STATES POSTAL SERVICE MAILABILITY:

Hazard class: Not given
Mailability: Nonmailable
Boxes per parcel: 0

HAZARD CODES:

HEALTH HAZARD (BLUE): (3) Extremely hazardous to health. Full protection
required. No skin surface should be exposed.

FLAMMABILITY (RED) : (4) This material forms readily ignitable mixtures
in air.

REACTIVITY (YELLOW): (0) Stable even under fire conditions.

SPECIAL : Unspecified

----- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON -----

ACGIH TLV list "Threshold Limit Values for 1989-1990"
 California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
 Clean Air Act of November 15, 1990. List of pollutants.
 DOT Hazardous Materials Table. 49 CFR 172.101
 EPA TSCA Chemical Inventory List 1989
 EPA TSCA Chemical Inventory List 1990
 EPA TSCA Chemical Inventory List 1992
 EPA TSCA Test Submission (TSCATS) Database - April 1990
 EPA TSCA Test Submission (TSCATS) Database - September 1989
 HYDROGEN SULFIDE [7783-06-4]
 Massachusetts Substance List.
 New Jersey DEQ100 list for release reporting.
 New Jersey Right To Know Substance List. (December 1987)
 OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
 OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
 Pennsylvania Hazardous Substance List
 RCRA Hazardous Waste
 SARA Title III Extremely Hazardous Substance. Sections 302 and 304.
 Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
 Washington State Discarded Chemical Products List, November 17, 1989
 Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

----- TOXICITY DATA -----

SHORT TERM TOXICITY: INHALATION: levels of 20 ppm may cause headache, loss
 of appetite and dizziness. 50 ppm may cause muscle
 fatigue. 300 ppm may cause muscle cramps, low blood
 pressure, and unconsciousness after 20 minutes.
 levels of 500 ppm can cause immediate loss of
 consciousness, slowed respiration and death in 30 to
 60 minutes. at levels of 700 ppm and above
 respiratory paralysis and death can occur in seconds.
 non-fatal cases may recover fully or may experience
 abnormal reflexes, dizziness, sleep disturbances and
 loss of appetite that last for months or years. SKIN:
 readily absorbed. may cause irritation, reddening and
 swelling. contact with liquid can cause freezing
 burns. Eyes: irritation may be felt at levels as low
 as 0.1 ppm. levels of 10 ppm and above can cause
 irritation, pain, tearing, and increased light
 sensitivity. liquid may cause freezing burns.
 INGESTION: no reported cases. liquid may cause
 freezing burns. (NYDH)

LONG TERM TOXICITY: no effects reported. (NYDH)

TARGET ORGANS: resp sys, lungs, eyes

SYMPTOMS: Irritation of eyes, nose and throat. If high
 concentrations are inhaled, hyperpnea and respiratory
 paralysis may occur. Very high concentrations may

produce pulmonary edema. Source: CHRIS

NC IDLH: 300PPM

OSH REL: 10 ppm Ceiling exposures which shall at no time be exceeded(10-MIN) 15 mg/M3 Ceiling exposures which shall at no time be exceeded(10-MIN)

GIH TLV: TLV = 10ppm
GIH STEL: STEL = 15 ppm

HA PEL: Transitional Limits:
PEL = CEILING = 20 PPM; MAXIMUM PEAK ABOVE CEILING FOR 10 MI
Final Rule Limits:
TWA = 10 ppm (14 mg/M3)
STEL = 15 ppm(21 mg/M3)

K INFORMATION: 10 ppm
15 mg/M3
Substance has intense odor. Peak = 2xMAK for 10 minutes, 4 times per shift of 8 hours.

RCINOGEN?: N STATUS: See below

RCINOGEN LISTS:

IARC: Not listed
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

MAN TOXICITY DATA: (Source: NIOSH RTECS)
* ihl-hmn LCLo:600 ppm/30M 29ZWAE -,207,68
ihl-man LDLo:5700 ug/kg AMPMAR 44,483,83
BEHAVIORAL
Coma
LUNGS, THORAX, OR RESPIRATION
Chronic pulmonary edema or congestion

50 value: No LD50 in RTECS 1992

HER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

ihl-rat LC50:444 ppm
ihl-mus LC50:634 ppm/1H
ihl-mam LCLo:800 ppm/5M

IRITATION DATA: (Source: NIOSH RTECS 1992)

reproductive toxicity (1992 RTECS):

This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

ihl-rat TCLO:20 ppm (6-22D preg/21D post) TIHEEC
6,389,90

EFFECTS ON NEWBORN

Physical

----- PROTECTION AND FIRST AID -----

PROTECTION SUGGESTED

FROM THE CHRIS MANUAL:

rubber-framed goggles; approved respiratory protection.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:

Prevent skin freezing.

WEAR EYE PROTECTION TO PREVENT:

Reasonable probability of eye contact.

** REMOVE CLOTHING:

Immediately remove any clothing that becomes wet.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)

NIOSH (HYDROGEN SULFIDE)

100 ppm: Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection.

250 ppm: Any supplied-air respirator operated in a continuous flow mode. * Substance reported to cause eye irritation or damage may require eye protection.

0 ppm: Any self-contained breathing apparatus with a full facepiece. / Any supplied-air respirator with a full facepiece.

EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.:

Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

ESCAPE: Any air purifying full facepiece respirator (gas mask) with a chin-style or front- or back- mounting canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: CHRIS Manual 1991

INHALATION: remove victim from exposure; if breathing has stopped, give artificial respiration; administer oxygen if needed; consult physician.

ES: wash with plenty of water.

RST AID SOURCE: DOT Emergency Response Guide 1990.

ve victim to fresh air and call emergency medical care; if not
eathing, give artificial respiration; if breathing is difficult, give
ygen. In case of contact with material, immediately flush skin or eyes
th running water for at least 15 minutes. Keep victim quiet and
intain normal body temperature. Effects may be delayed; keep victim
der observation.

----- INITIAL INCIDENT RESPONSE -----

RE EXTINGUISHMENT: Stop flow of gas. CHRIS91

Department of Transportation Guide to Hazardous Materials Transport
Information - Publication DOT 5800.5 (1990).

ST SHIPPING NAME: Hydrogen sulfide, liquefied

ST ID NUMBER: UN1053

RG90

GUIDE 13

* POTENTIAL HAZARDS *

HEALTH HAZARDS

Poison; extremely hazardous.

May be fatal if inhaled or absorbed through skin.

Initial odor may be irritating, foul or absent and may deaden your sense
of smell.

Runoff from fire control or dilution water may cause pollution.

FIRE OR EXPLOSION

Some of these materials are extremely flammable.

May be ignited by heat, sparks or flames.

Vapors may travel to a source if ignition and flash back.

Cylinder may explode in heat of fire.

Vapor explosion and poison hazard indoors, outdoors or in sewers.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind, out of low areas, and ventilate closed spaces before
entering.

Positive pressure self-contained breathing apparatus (SCBA) and chemical
protective clothing which is specifically recommended by the shipper
or manufacturer may be worn. It may provide little or no thermal
protection.

Structural firefighters' protective clothing is not effective for these
materials.

Isolate the leak or spill area immediately for at least 150 feet in all
directions.

See the Table of Initial Isolation and Protective Action Distances.

If you find the ID Number and the name of the material there, begin
protective action.

Isolate for 1/2 mile in all directions if tank, rail car or tank truck
is involved in fire.

CALL CHEMTREC AT 1-800-424-9300 AS SOON AS POSSIBLE, especially if there is no local hazardous materials team available.

***FIRE**

Small Fires: Let burn unless leak can be stopped immediately.

Large Fires: Water spray, fog or regular foam.

Move container from fire area if you can do it without risk.

Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

Cool container with water using unmanned device until well after fire is out.

Isolate area until gas has dispersed.

***SPILL OR LEAK**

Do not touch or walk through spilled material; stop leak if you can do it without risk.

Shut off ignition sources; no flares, smoking or flames in hazard area.

Use water spray to reduce vapor; do not put water directly on leak or spill area.

Isolate area until gas has dispersed.

***FIRST AID**

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.

In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes.

Keep victim quiet and maintain normal body temperature.

Effects may be delayed; keep victim under observation.

ISOLATION DISTANCES FROM ERG90

Small spills:

First isolate in all directions - 1500 ft

Then protect persons downwind - 5 miles

Large spills:

First isolate in all directions - 1500 ft

Then protect persons downwind - 5 miles

DISCLAIMER: The data shown above on this chemical represents a best effort on the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the guidelines and limitations of the user's CHEMTOX license agreement. The COMPILERS of the CHEMTOX database shall not be held liable for inaccuracies or omissions within this database, or in any of its printed or displayed output forms.

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----- IDENTIFIERS -----

LAST UPDATE OF THIS RECORD: 06/03/93

RTECS: OF7525000

MOL WT: 207.19

HEMICAL CLASS: Metal

See other identifiers listed below under Regulations.

----- PROPERTIES -----

PHYSICAL DESCRIPTION: bluish-grey, soft metal; heavy ductile, soft, gray solid

MELTING POINT:	600.6 K	327.4 C	621.4 F
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FLASH POINT: NA

AUTO IGNITION: NA

'APOR PRESSURE: 1mm @ 973 C

TEL: NA

LEL: NA

VAPOR DENSITY:	No data
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SPECIFIC GRAVITY: 11.34

DENSITY: 11.34 g/mL @ 20 C

WATER SOLUBILITY: INSOLUBLE; DISSOLVES SLOWLY IN WATER
CONTAINING A WEAK ACID

INCOMPATIBILITIES: strong ox, hydrogen peroxide, active metals, sodium, potassium, chlorine trifluoride, hydrogen peroxide, zirconium, disodium acetylide, oxidants

ACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: RELATIVELY IMPENETRABLE TO RADIATION

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: WHEN HEATED EMITS HIGHLY TOXIC FUMES;
CAN REACT VIGOROUSLY WITH OXIDIZING
MATERIALS

ODOR DETECTED AT (ppm): Unknown

ODOR DESCRIPTION: No data

100 % ODOR DETECTION: No data

----- REGULATIONS -----

tional Primary Ambient Air Quality Standards
5 ug/M3 maximum arithmetic mean averaged over a calendar year
tional Secondary Ambient Air Quality Standards
me as primary standard

T hazard class: 6.1 POISON
T guide: 53
entification number: UN2291
T shipping name: LEAD COMPOUNDS, SOLUBLE, N.O.S.
cking group: II
bel(s) required: POISON
ecial provisions:
ckaging exceptions: 173.153
n bulk packaging: 173.213
lk packaging: 173.240
ntity limitations-
ssenger air/rail: 100 KG
rgo aircraft only: 200 KG
sse stowage: A
her towage provisions:

CC NUMBER: Not listed

EAN WATER ACT Sect.307:Yes

EAN WATER ACT Sect.311:No

tional Primary Drinking Water Regulations

Maximum Contaminant Levels (MCL): 0.05 mg/L (12/07/92)

Maximum Contaminant Level Goals (MCLG): 0 mg/L (12/07/92)

EAN AIR ACT: CAA '90 By category and CAA '77 Sect 109

A WASTE NUMBER: D008

RCLA REF: Y

DESIGNATION: X 1 pound (0.454 kg) CERCLA for pieces of solid meta
with diameter less than 100 micrometers (0.004
inches).

RA TPQ VALUE: Not listed

RA Sect. 312

categories:

Chronic toxicity: carcinogen

Chronic toxicity: adverse effect to target organ
after long period of exposure.

Chronic toxicity: mutagen.

Chronic toxicity: reproductive toxin.

STED IN SARA Sect 313: Yes

minimus CONCENTRATION: 0.1 percent

ITED STATED POSTAL SERVICE MAILABILITY:

zard class: ORM-B

ilability: Domestic service and air transportation; shipper's declaration

x per parcel: 25 LBS; 5 LBS

PA CODES:

HEALTH HAZARD (BLUE): Unspecified
FLAMMABILITY (RED) : Unspecified
REACTIVITY (YELLOW): Unspecified
SPECIAL : Unspecified

----- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON -----

ACGIH TLV list "Threshold Limit Values for 1989-1990"
alifornia Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
alifornia Assembly Bill 1807 Toxic Air Contaminants.
California Proposition 65 Developmental Toxin List
alifornia Proposition 65 Female Reproductive Toxin List
alifornia Proposition 65 Male Reproductive Toxin List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 109 National Ambient Air Quality Standards List
lean Air Act of November 15, 1990. List of pollutants.
lean Water Act Section 307 Priority Pollutants
DOT Marine Pollutant. Proposed list. 57 FR 3854, Jan 31, 1992
PA TSCA Chemical Inventory List 1986
PA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
A TSCA Chemical Inventory List 1992
PA TSCA Test Submission (TSCATS) Database - April 1990
LPA TSCA Test Submission (TSCATS) Database - September 1989
LEAD [7439-92-1]
assachusetts Substance List.
ew Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
New Jersey Right to Know Substance List. Listed as a teratogen.
SHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Specifically regulated substance. See 29 CFR 1910.1025
Pennsylvania Hazardous Substance List
CRA Hazardous Waste
CRA Toxicity Characteristics (TC) list dated March 29, 1990
SARA Section 313 Toxic Chemicals List

----- TOXICITY DATA -----

SHORT TERM TOXICITY: LASSITUDE, INSOMNIA, PALLOR, EYE GROUND, ANOREXIA,
LOW-WEIGHT, MALNUTRITION, CONSTIPATION, ABDOMINAL
PAIN, COLIC; HYPOTENSE, ANEMIA; GINGIVAL LEAD LINE;
TREMBLING PARALYSIS WRIST. ** Source: 2

LONG TERM TOXICITY: unknown

TARGET ORGANS: gi,CNS,kidneys,blood,gingival tissue

SYMPTOMS: LASS, INSOM, PAL, EYE GROUND, ANOR, LOW-WT, MALNUT,
CONSTI, ABDOM PAIN, COLIC; HYPOTENSE, ANEMIA, GINGIVAL
LEAD LINE; TREM, PARA WRIST. METALLIC TASTE, INCREASED
SALIVATION, PYORRHEA (FLOW OF MUCOUS). NEUROMUSCULAR:
NUMBNESS AND TINGLING OF EXTREMITIES WITH SENSORY

DISTRUBANCE, EXTENSOR WEAKNESS OF WRISTS AND ANKLES, LOSS OF MUSCLE TONE, TREMOR INCREASED DEEP-TENDON REFLEXES, MUSCULAR CRAMPS AND ACHING, MUSCULAR ATROPHY. CNS: VISUAL DISTURBANCES, HEADACHE, NERVOUSNESS OF DEPRESSION, INSOMNIA, MENTAL CONFUSION, DELIRIUM. Source: NIOSHP, THIC

NC IDLH: 700mg/M3

OSH REL: <0.1 mg/M3 Air level to be maintained so that worker blood level remains <0.06 mg/100 g of whole blood

GIH TLV: TLV = 0.15mg/M3

GIH STEL: Not listed

HA PEL: Final Rule Limits:
TWA = See 29 CFR 1910.1025
50 ug/M3

K INFORMATION: 0.1 mg/M3
Substance with systemic effects, onset of effect over 2 hours: Peak = 10xMAK for 30 minutes, once per shift of 8 hours.

RCINOGEN?: Y STATUS: See below

RCINOGEN LISTS:

IARC: Carcinogen defined by IARC
to be possibly carcinogenic to
humans, but having (usually) no
human evidence.

MAK: Not listed

NIOSH: Not listed

NTP: Not listed

ACGIH: Not listed

OSHA: Not listed

MAN TOXICITY DATA: (Source: NIOSH RTECS)

orl-wmn TDLo:450 mg/kg/6Y JAMAAP 237,2627,77

PERIPHERAL NERVE AND SENSATION

Flaccid paralysis without anesthesia
BEHAVIORAL

Hallucinations, distorted perceptions
BEHAVIORAL

Muscle weakness

50 value: No LD50 in RTECS 1992

HER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

ipr-rat LDLo:1 gm/kg

orl-pgn LDLo:160 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):

This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

orl-rat TDLo:790 mg/kg (multigenerations) AEHLAU
23,102,71

EFFECTS ON EMBRYO OR FETUS

Fetotoxicity(except death,e.g.,stunted fetus)

EFFECTS ON EMBRYO OR FETUS

Fetal death

orl-rat TDLo:1140 mg/kg (14D pre-21D post) PHMCAA
20,201,78

EFFECTS ON NEWBORN

Behavioral

orl-rat TDLo:520 mg/kg (7-22D preg/10D post) FEPRA7
37,394,78

EFFECTS ON NEWBORN

orl-rat TDLo:1100 mg/kg (1-22D preg) FEPRA7 37,895,78
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and
marrow)

EFFECTS ON NEWBORN

Growth statistics(e.g.,reduced weight gain)

ihl-rat TCLo:10 mg/m3/24H (1-21D preg) ZHPMAT
165,294,77

EFFECTS ON EMBRYO OR FETUS

Fetotoxicity(except death,e.g.,stunted fetus)

SPECIFIC DEVELOPMENTAL ABNORMALITIES

Blood and lymphatic systems(including spleen and
marrow)

ihl-rat TCLo:3 mg/m3/24H (1-21D preg) ZHPMAT 165,294,77
EFFECTS ON NEWBORN

orl-mus TDLo:1120 mg/kg (multigenerations) AEHLAU
23,102,71

EFFECTS ON EMBRYO OR FETUS

Fetotoxicity(except death,e.g.,stunted fetus)

EFFECTS ON EMBRYO OR FETUS

Fetal death

orl-mus TDLo:6300 mg/kg (1-21D preg) EXPEAM 31,1312,75
EFFECTS ON FERTILITY

Female fertility index
EFFECTS ON FERTILITY
Pre-implantation mortality

orl-mus TDLo:300 mg/kg (1-2D preg) TXCYAC 6,129,76
EFFECTS ON FERTILITY
Other measures of fertility

orl-mus TDLo:4800 mg/kg (1-16D preg) BECTA6 18,271,77
EFFECTS ON EMBRYO OR FETUS
Cytological changes(including somatic cell genetic material)

orl-dom TDLo:662 mg/kg (1-21W preg) TXAPA9 25,466,73
EFFECTS ON NEWBORN
Behavioral

SIGNIFICANT
SK LEVEL(Ca P65): E0.5 micrograms/day

----- EPA's IRIS DATA SUMMARY -----
ad and compounds (inorganic); CASRN 7439-92-1 (04/01/92)

I. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Lead and compounds (inorganic)
CASRN -- 7439-92-1
Last Revised -- 05/01/91

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- B2; probable human carcinogen

Basis -- Sufficient animal evidence. Ten rat bioassays and one mouse assay have shown statistically significant increases in renal tumors with dietary and subcutaneous exposure to several soluble lead salts. Animal assays provide reproducible results in several laboratories, in multiple rat strains with some evidence of multiple tumor sites. Short term studies show that lead affects gene expression. Human evidence is inadequate.

II.A.2. HUMAN CARCINOGENICITY DATA

Inadequate. There are four epidemiologic studies of occupational cohorts exposed to lead and lead compounds. Two studies (Dingwall-Fordyce and Lane, 1963; Nelson et al., 1982) did not find any association between exposure and cancer mortality. Selevan et al. (1985), in their retrospective cohort mortality study of primary lead smelter workers, found a slight decrease in the total cancer mortality (SMR=95). Apparent excesses were observed for respiratory cancer (SMR=111, obs=41, $p>0.05$) and kidney cancer (SMR=204, obs=6, $p>0.05$). Cooper and Gaffey (1975) and Cooper (1985 update) performed a cohort mortality study of battery plant workers and lead smelter workers. They found statistically significant excesses for total cancer mortality (SMR=113, obs=344), stomach cancer (SMR=168, obs=34), and lung cancer (SMR=124, obs=109) in the battery plant workers. Although similar excesses were observed in the smelter workers, they were not statistically significant. Cooper and Gaffey (1975) felt it was possible that individual subjects were monitored primarily on the basis of obvious signs of lead exposure, while others who showed no symptoms of lead poisoning were not monitored.

All of the available studies lacked quantitative exposure information, as well as information on the possible contribution from smoking. All studies also included exposures to other metals such as arsenic, cadmium, and zinc for which no adjustment was done. The cancer excesses observed in the lung and stomach were relatively small (<200). There was no consistency of site among the various studies, and no study showed any dose-response relationship. Thus, the available human evidence is considered to be inadequate to refute or demonstrate any potential carcinogenicity for humans from lead exposure.

II.A.3. ANIMAL CARCINOGENICITY DATA

Sufficient. The carcinogenic potential of lead salts (primarily phosphates and acetates) administered via the oral route or by injection has been demonstrated in rats and mice by more than 10 investigators. The most characteristic cancer response is bilateral renal carcinoma. Rats given lead acetate or subacetate orally have developed gliomas, and lead subacetate also produced lung adenomas in mice after i.p. administration. Most of these investigations found a carcinogenic response only at the highest dose. The lead compounds tested in animals are almost all soluble salts. Metallic lead, lead oxide and lead tetraalkyls have not been tested adequately. Studies of inhalation exposure have not been located in the literature.

Azar et al. (1973) administered 10, 50, 100, and 500 ppm lead as lead

etate in dietary concentrations to 50 rats/sex/group for 2 years. Control rats (100/sex) received the basal laboratory diet. In a second 2-year feeding study, 20 rats/group were given diets containing 0, 1000, and 2000 ppm lead as lead acetate. No renal tumors were reported in the control groups or in treated animals of either sex receiving 10 to 100 ppm. Male rats fed 500, 1000, and 2000 ppm lead acetate had an increased renal tumor incidence of 5/20, 10/20, and 16/20, while 7/20 females in the 2000-ppm group developed renal tumors.

The Azar et al. (1973) study is limited by the lack of experimental detail. The possibility of environmental contamination from lead in the air or drinking water was not mentioned. The strains of rats used were not specified in the study, but the Health Effects Assessment for Lead (U.S. EPA, 1984) indicates the rats were Wistar strain. The weight gain at 1000 and 2000 ppm was reported to be depressed, but details were not given.

Kasprzak et al. (1985), in investigating the interaction of dietary calcium on lead carcinogenicity, fed 1% lead subacetate (8500 ppm Pb) to male Sprague-Dawley rats in the diet for 79 weeks. Of the rats surviving (29/30) in this treatment group beyond 58 weeks, 44.8% had renal tumors. Four rats had adenocarcinomas; the remaining nine had adenomas. Bilateral tumors were noted. No renal tumors were noted among the controls.

As part of a study to determine interactions between sodium nitrite, ethyl alcohol, and lead, male Sprague-Dawley rats were given lead acetate in their drinking water for 76 weeks (Koller et al., 1986). The concentration of lead was 2600 ppm. No kidney tumors were detected among the 10 control rats. Thirteen of 16 (81%) lead-treated rats had renal tubular carcinoma; three tumors were detected at 72 weeks and the remainder detected at the termination of the study.

Van Esch and Kroes (1969) fed basic lead acetate at 0, 0.1%, and 1.0% in the diet to 25 Swiss mice/sex/group for 2 years. No renal tumors developed in the control group, but 6/25 male mice of 0.1% basic lead acetate group had renal tumors (adenomas and carcinomas combined). In the 1.0% group, one male had a renal tumor. The authors thought that the low incidence in the 0% group was due to early mortality.

Hamsters given lead subacetate at 0.5% and 1% in the diet had no significant renal tumor response (Van Esch and Kroes, 1969).

II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

Lead acetate induces cell transformation in Syrian hamster embryo cells (DiPaolo et al., 1978) and also enhances the incidence of simian adenovirus induction. Lead oxide showed similar enhanced adenovirus induction (Casto et al., 1979).

Under certain conditions lead compounds are capable of inducing chromosomal aberrations in vivo and in tissue cultures. Grandjean et al. (1983) showed a relationship between SCE and lead exposure in exposed workers.

Lead has been shown, in a number of DNA structure and function assays, to affect the molecular processes associated with the regulation of gene expression (U.S. EPA, 1986).

II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available.

Quantifying lead's cancer risk involves many uncertainties, some of which may be unique to lead. Age, health, nutritional state, body burden, and exposure duration influence the absorption, release, and excretion of lead. In addition, current knowledge of lead pharmacokinetics indicates that an estimate derived by standard procedures would not truly describe the potential risk. Thus, the Carcinogen Assessment Group recommends that a numerical estimate not be used.

II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

Not available.

II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

II.D.1. EPA DOCUMENTATION

U.S. EPA. 1984. Health Effects Assessment for Lead. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH, for the Office of Emergency and Remedial Response, Washington, DC. EPA/540/1-86/055. NTIS PB85-163996/AS.

U.S. EPA. 1986. Air Quality Criteria Document for Lead. Volumes III, IV. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Research Triangle Park, NC, for the Office of Air Quality Planning and Standards. EPA-600/8-83/028dF.

U.S. EPA. 1987. Preliminary review of the carcinogenic potential of lead associated with oral exposure. Prepared by the Office of Health and Environmental Assessment, Carcinogenic Assessment Group, Washington DC, for the Office of Drinking Water, Office of Solid Waste and the Office of Emergency and Remedial Response (Superfund). OHEA-C-267. Internal Review Draft.

II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The review of the carcinogenic potential of lead associated with oral exposure has received Agency review.

The 1986 Air Quality Criteria Document for Lead has received Agency and Internal Review.

Agency Work Group Review: 05/04/88

Classification Date: 05/04/88

II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

William Pepelko / ORD -- (202)260-5898 / FTS 260-5898

Mes Cogliano / ORD -- (202)260-9243 / FTS 260-9243

----- PROTECTION AND FIRST AID -----

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

EXPOSED PERSONNEL SHOULD WASH:
At the end of each work shift.

REMOVE CLOTHING:
Promptly remove non-impervious clothing that becomes contaminated.

REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
LEAD
At in excess of 0.5 mg/M3: Half-mask, air-purifying respirator
equipped with high efficiency filters.
At in excess of 2.5 mg/M3: Full facepiece air-purifying respirator
equipped with high-efficiency filters.

Not in excess of 50 mg/M3: (1) Any powered, air-purifying respirator with high efficiency filters; or (2) Half-mask supplied-air respirator operated in positive-pressure mode.

Not in excess of 100 mg/M3: Supplied air respirator with full facepiece hood, or helmet or suit and operated in positive pressure mode.

Unknown concentration or Firefighting: Full facepiece, self-contained breathing apparatus operated in positive-pressure mode.

FIRST AID SOURCE: NIOSH

EYE: irr immed

SKIN: soap flush promptly

INHALATION: art resp

INGESTION: water, vomit

FIRST AID SOURCE: DOT Emergency Response Guide 1990.

Move victim to fresh air; call emergency medical care. In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes. Remove and isolate contaminated clothing and shoes at the site.

----- INITIAL INCIDENT RESPONSE -----

Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).

DOT SHIPPING NAME: LEAD COMPOUNDS, SOLUBLE, N.O.S.

DOT ID NUMBER: UN2291

ERG90

GUIDE 53

* POTENTIAL HAZARDS *

HEALTH HAZARDS

Poisonous if swallowed.

Inhalation of dust poisonous.

Fire may produce irritating or poisonous gases.

Runoff from fire control or dilution water may cause pollution.

* FIRE OR EXPLOSION

Some of these materials may burn, but none of them ignites readily.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.

Stay upwind; keep out of low areas.

Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.

CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.

* FIRE

Small Fires: Dry chemical, CO2, water spray or regular foam.

Large Fires: Water spray, fog or regular foam.

Move container from fire area if you can do it without risk.

* SPILL OR LEAK

Do not touch or walk through spilled material; stop leak if you can do it without risk.

Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.

Small Dry Spills: With clean shovel place material into clean, dry container and cover; move containers from spill area.

Large Spills: Dike far ahead of liquid spill for later disposal.

IRST AID

Move victim to fresh air; call emergency medical care.

In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes.

Remove and isolate contaminated clothing and shoes at the site.

SCCLAIMER: The data shown above on this chemical represents a best effort on the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the guidelines and limitations of the user's CHEMTOX license agreement. The COMPILERS of the CHEMTOX database shall not be held liable for inaccuracies, omissions within this database, or in any of its printed or displayed outputs.

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----- IDENTIFIERS -----

LAST UPDATE OF THIS RECORD: 06/03/93

See other identifiers listed below under Regulations.

----- PROPERTIES -----

TOXIC FIRE GASES:	None reported other than possible unburned vapors
ODOR DETECTED AT (ppm):	50 ppm
ODOR DESCRIPTION:	Chloroform-like; ethereal Source:CHRIS
00 % ODOR DETECTION:	No data

----- REGULATIONS -----

Page 1

entification number: UN1710
T shipping name: Trichloroethylene
cking group: III
bel(s) required: KEEP AWAY FROM FOOD
ecial provisions: N36,T1
ckaging exceptions: 173.153
n bulk packaging: 173.203
lk packaging: 173.241
antity limitations-
ssenger air/rail: 60 L
rgo aircraft only: 220 L
ssel stowage: A
her stowage provisions: 40,M2

CC NUMBER: 4941771

LEAN WATER ACT Sect.307:Yes

LEAN WATER ACT Sect.311:No

tional Primary Drinking Water Regulations

Maximum Contaminant Levels (MCL): 0.005 mg/L (01/09/89)

Maximum Contaminant Level Goals (MCLG): 0 mg/L (01/09/89)

LEAN AIR ACT: CAA '90 Listed

A WASTE NUMBER: U228,D040

RCLA REF: Not listed

DESIGNATION: B 100 pounds (45.4 kg) CERCLA

RA TPQ VALUE: Not listed

RA Sect. 312

categories:

Acute toxicity: Toxic. LD50 > 50 and <= 500
mg/kg (oral rat).

Acute toxicity: Irritant

Acute toxicity: adverse effect to target organs.

Chronic toxicity: adverse effect to target organ
after long period of exposure.

Chronic toxicity: mutagen.

Chronic toxicity: reproductive toxin.

STED IN SARA Sect 313: Yes

minimus CONCENTRATION: 1.0 percent

ITED STATED POSTAL SERVICE MAILABILITY:

zard class: ORM-A

ilability: Domestic service and air transportation; shipper's declaration

x per parcel: 10 GAL;1 PT

PA CODES:

HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with
self-contained breathing apparatus.

FLAMMABILITY (RED) : (1) This material must be preheated before ignition
can occur.

REACTIVITY (YELLOW): (0) Stable even under fire conditions.

SPECIAL : Unspecified

----- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON -----

ACGIH TLV list "Threshold Limit Values for 1989-1990"
ATSDR Toxicology Profile available (NTIS** PB/90/127523/AS)
California Assembly Bill 1803 Well Monitoring Chemicals.
California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
California Assembly Bill 1807 Toxic Air Contaminants.
California Proposition 65 Carcinogen List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 111 List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
DOT Hazardous Materials Table. 49 CFR 172.101
DOT Marine Pollutant. Proposed list. 57 FR 3854, Jan 31, 1992
EPA Carcinogen Assessment Group List
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
New Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
New Jersey Right to Know Substance List. Listed as a carcinogen.
New Jersey Right to Know Substance List. Listed as a mutagen.
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
Pennsylvania Hazardous Substance List
RCRA Hazardous Constituents for Ground Water Monitoring. Ap'dx IX to 40 CFR 264
RCRA Hazardous Waste
RCRA Toxicity Characteristics (TC) list dated March 29, 1990
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
TRICHLOROETHYLENE [79-01-6]
Washington State Discarded Chemical Products List, November 17, 1989
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

----- TOXICITY DATA -----

SHORT TERM TOXICITY: INHALATION: headache, sleepiness, nausea, vomiting, dizziness and coughing have been felt around 100 ppm. unconsciousness can result at 3,000 ppm. exposure to 8,000 ppm can cause death. SKIN: can be absorbed through skin. may cause irritation, burning or redness. Eyes: may cause irritation, burning or watering. INGESTION: can cause drunkenness, vomiting, diarrhea or abdominal pain. unconsciousness, liver or kidney damage, vision distortion and death have been reported at large doses. (NYDH)

LONG TERM TOXICITY: contact with levels near 100 ppm can casue giddiness, nervous exhaustion, increased sensitivity to alcohol

including redness in the face (trichloroethylene blush), the ability to become addicted to the vapor, as well as effects of acute exposure listed above. higher levels can alter one's heart rate. repeated contact with hands can cause excessive dryness, cracking, burning, loss of sense of touch or temporary paralysis of fingers. most of these effects seem to go away after exposure has stopped. trichloroethylene is considered a cancer suspect agent because high levels cause liver cancer in mice. whether it causes cancer in humans is unknown. (NYDH)

RGET ORGANS: eyes, skin, nose, throat, resp. system, heart, liver, kidneys, CNS.

MPTOMS: INHALATION: symptoms range from irritation of the nose and throat to nausea, an attitude of irresponsibility, blurred vision, and finally disturbance of central nervous system resulting in cardiac failure. Chronic exposure may cause organic injury. INGESTION: symptoms similar to inhalation. SKIN: defatting action can cause dermatitis. EYES: slightly irritating sensation and lachrymation. Source: CHRIS

NC IDLH: 1000ppm

OSH REL: Potential occupational carcinogen 25 ppm Time weighted averages for 8-hour exposure

GIH TLV: TLV = 50ppm

GIH STEL: STEL = 200 ppm

HA PEL: Final Rule Limits:
TWA = 50 ppm (270 mg/M3)
STEL = 200 ppm(1080 mg/M3)

K INFORMATION: 50 ppm
270 mg/M3
Substance with systemic effects, onset of effect less than or equal to 2 hrs: Peak = 5xMAK for 30 minutes, 2 times per shift of 8 hours.
There is no reason to fear a risk of damage to the developing embryo or fetus when MAK values are adhered to.

RCINOGEN?: N STATUS: See below

REFERENCES:
ANIMAL SUSPECTED IARC** 20,545,79
ANIMAL POSITIVE IARC** 11,263,76
HUMAN INDEFINITE IARC** 20,545,79

RCINOGEN LISTS:

IARC: Not classified as to human
carcinogenicity or probably not
carcinogenic to humans.

MAK: Not listed

NIOSH: Carcinogen defined by NIOSH
with no further categorization.

NTP: Not listed

ACGIH: Not listed

OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

* orl-hmn LDLo:7 gm/kg ARTODN 35,295,76

orl-man TDLo:2143 mg/kg 34ZIAG -,602,69
GASTROINTESTINAL
Other changes

ihl-hmn TCLo:6900 mg/m3/10M AHBAAM 116,131,36
BEHAVIORAL
Somnolence(general depressed activity)
BEHAVIORAL
Hallucinations, distorted perceptions

ihl-hmn TCLo:160 ppm/83M AIHAAP 23,167,62
BEHAVIORAL
Hallucinations, distorted perceptions

ihl-hmn TDLo:812 mg/kg BMJOAE 2,689,45
BEHAVIORAL
Somnolence(general depressed activity)
GASTROINTESTINAL
Other changes
LIVER
Jaundice, other or unclassified

ihl-man TCLo:110 ppm/8H BJIMAG 28,293,71
SENSE ORGANS
Eye
Other
BEHAVIORAL
Hallucinations, distorted perceptions

LD50 value: No LD50 in RTECS 1992

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

ihl-rat LCLo:8000 ppm/4H
ipr-rat LD50:1282 mg/kg
orl-mus LD50:2402 mg/kg
ihl-mus LC50:8450 ppm/4H
scu-mus LD50:16 gm/kg
ivn-mus LD50:33900 ug/kg
ipr-dog LD50:1900 mg/kg

scu-dog LDLo:150 mg/kg
ivn-dog LDLo:150 mg/kg
orl-cat LDLo:5864 mg/kg
ihl-cat LCLo:32500 mg/m3/2H
orl-rbt LDLo:7330 mg/kg
ihl-rbt LCLo:11000 ppm
scu-rbt LDLo:1800 mg/kg
ihl-gpg LCLo:37200 ppm/40M

RITATION DATA: (Source: NIOSH RTECS 1992)

productive toxicity (1992 RTECS):

This chemical is a mammalian reproductive toxin.

PRODUCTIVE TOXICITY DATA (1992 RTECS)

orl-rat TDLo:2688 mg/kg (1-22D preg/21D post) TOXID9
4,179,84

EFFECTS ON NEWBORN
Behavioral

orl-rat TDLo:36 gm/kg (15D pre/1-21D preg) TXCYAC
32,229,84

EFFECTS ON NEWBORN
Weaning or lactation index(#alive at weaning per #
alive at day 4)

orl-rat TDLo:1140 mg/kg (14D pre-21D post) BRREAP
488,403,89

SPECIFIC DEVELOPMENTAL ABNORMALITIES
Central nervous system

ihl-rat TCLo:1800 ppm/24H (1-20D preg) APTOD9 19,A22,80

SPECIFIC DEVELOPMENTAL ABNORMALITIES

Musculoskeletal system

SPECIFIC DEVELOPMENTAL ABNORMALITIES

Other developmental abnormalities

ihl-rat TCLo:100 ppm/4H (6-22D preg) JPHYA7 276,24P,78

EFFECTS ON FERTILITY

Post-implantation mortality

EFFECTS ON EMBRYO OR FETUS

Fetotoxicity(except death,e.g.,stunted fetus)

ihl-rat TCLo:1800 ppm/6H (1-20D preg) TXCYAC 14,153,79

SPECIFIC DEVELOPMENTAL ABNORMALITIES

Urogenital system

ihl-rat TCLo:100 ppm/4H (8-21D preg) BJANAD 54,337,82

SPECIFIC DEVELOPMENTAL ABNORMALITIES

Musculoskeletal system

ihl-mus TCLo:100 ppm/7H (5D male) NTIS** PB82-185075

PATERNAL EFFECTS
Spermatogenesis

NO SIGNIFICANT
RISK LEVEL(Ca P65): 60 micrograms/day

----- PROTECTION AND FIRST AID -----

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

- ** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.
- ** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.
- ** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes wet.
- ** REMOVE CLOTHING:
Promptly remove non-impervious clothing that becomes wet.
- ** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (TRICHLOROETHYLENE)
Greater at any detectable concentration. : Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: NIOSH
EYE: irr immed
SKIN: soap wash promptly
INHALATION: art resp
INGESTION: ipecac, vomit

FIRST AID SOURCE: CHRIS Manual 1991
Do NOT administer adrenalin or epinephrine; get medical attention for all cases of overexposure.
INHALATION: remove victim to fresh air; if necessary, apply artificial respiration and/or administer oxygen.
INGESTION: have victim drink water and induce vomiting; repeat three times; then give 1 tablespoon epsom salts in water.

ES: flush thoroughly with water.
IN: wash thoroughly with soap and warm water.

RST AID SOURCE: DOT Emergency Response Guide 1990.
ve victim to fresh air and call emergency medical care; if not
eathing, give artificial respiration; if breathing is difficult, give
ygen. In case of contact with material, immediately flush eyes with
nning water for at least 15 minutes. Wash skin with soap and water.
move and isolate contaminated clothing and shoes at the site. Use first
d treatment according to the nature of the injury.

----- INITIAL INCIDENT RESPONSE -----

RE EXTINGUISHMENT: Water fog. CHRIS91

Department of Transportation Guide to Hazardous Materials Transport
formation - Publication DOT 5800.5 (1990).

T SHIPPING NAME: Trichloroethylene

T ID NUMBER: UN1710

G90

GUIDE 74

* POTENTIAL HAZARDS *

HEALTH HAZARDS

Vapors may cause dizziness or suffocation.
Exposure in an enclosed area may be very harmful.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

IRE OR EXPLOSION

Some of these materials may burn, but none of them ignites readily.
Most vapors heavier than air.
Air/vapor mixtures may explode when ignited.
Container may explode in heat of fire.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind, out of low areas, and ventilate closed spaces before
entering.

Positive pressure self-contained breathing apparatus (SCBA) and structural
firefighters' protective clothing will provide limited protection.
Isolate 1/2 mile in all directions if tank, rail car or tank truck is
involved in fire.

Remove and isolate contaminated clothing at the site.

CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE.

If water pollution occurs, notify the appropriate authorities.

IRE

Small Fires: Dry chemical or CO2.

Large Fires: Water spray, fog or regular foam.

Apply cooling water to sides of containers that are exposed to flames
until well after fire is out. Stay away from ends of tanks.

PILL OR LEAK

Shut off ignition sources; no flares, smoking or flames in hazard area.
Stop leak if you can do it without risk.

Small Liquid Spills: Take up with sand, earth or other noncombustible absorbent material.

Large Spills: Dike far ahead of liquid spill for later disposal.

***FIRST AID**

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.

In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.

Remove and isolate contaminated clothing and shoes at the site.

Use first aid treatment according to the nature of the injury.

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CHEMTOX DATA

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----- IDENTIFIERS -----

CHEMTOX RECORD 419

LAST UPDATE OF THIS RECORD: 06/03/93

NAME: VINYL CHLORIDE

SYNONYMS: CHLOROETHYLENE; VINYL CHLOROIDE; CHLOROETHEN;
CHLOROETHYLENE; CHLORURE DE VINYLE (FRENCH); CHLORO DI
VINYLE (ITALIAN); ETHYLENE MONOCHLORIDE; MONOCHLOROETHENE;
MONOCHLOROETHYLENE (DOT); VINYL CHLORIDE MONOMER; VINYL C
MONOMER; WINYLU CHLORED (POLISH); VCM; VCL

CAS: 75-01-4

RTECS: KU9625000

FORMULA: C2H3Cl

MOL WT: 62.50

WLN: G1U1

CHEMICAL CLASS: Vinyl halide

See other identifiers listed below under Regulations.

----- PROPERTIES -----

SICAL DESCRIPTION: colorless liquified compressed sag with a sweet odor

BOILING POINT:	259.4 K	-13.8 C	7.2 F
MELTING POINT:	119.4 K	-153.8 C	-244.8 F
FLASH POINT:	194 K	-79.15 C	-110.5 F
UTO IGNITION:	745 K	471.8 C	1373 F
CRITICAL TEMP:	431.6 K	158.45 C	317.21 F
CRITICAL PRESS:	5.34 kN/M2	52.6 atm	773 psia
EAT OF VAP:	160 Btu/lb	88.85 cal/g	3.718x E5 J/kg
EAT OF COMB:	-8136 Btu/lb	-4523 cal/g	-189x E5 J/kg
VAPOR PRESSURE:	2600 mm @ 25		
REL:	33 %		
EL:	3.6 %		
IONIZATION POTENTIAL (eV):	7.57		
VAPOR DENSITY:	2.2 (air=1) (air=1)		
PECIFIC GRAVITY:	0.969 @ -13C		
DENSITY:	0.969 g/cc or 9.0117 lb/gal		
WATER SOLUBILITY:	insol		
COMPATIBILITIES:			

REACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: No data

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: POLYMERIZES IN PRESENCE OF AIR,
SUNLIGHT, OR HEAT UNLESS STABILIZED BY
INHIBITORS.

TOXIC FIRE GASES: HCl and unburned toxic vapors

ODOR DETECTED AT (ppm): 260 ppm

ODOR DESCRIPTION: Pleasant, sweet Source: CHRIS

100 % ODOR DETECTION: No data

----- REGULATIONS -----

T hazard class: 2.1 FLAMMABLE GAS
 T guide: 17
 Identification number: UN1086
 T shipping name: Vinyl chloride, inhibited
 Packing group:
 Label(s) required: FLAMMABLE GAS
 Special provisions: B44
 Packaging exceptions: 173.306
 In bulk packaging: 173.304
 Bulk packaging: 173.314, 315
 Quantity limitations-
 Passenger air/rail: Forbidden
 Cargo aircraft only: 150 kg
 Hazmat stowage: B
 Other stowage provisions: 40

CC NUMBER: 4905792

FEAN WATER ACT Sect.307:Yes

FEAN WATER ACT Sect.311:No

tional Primary Drinking Water Regulations

Maximum Contaminant Levels (MCL): 0.002 mg/L (01/09/89)

Maximum Contaminant Level Goals (MCLG): 0 mg/L (01/09/89)

FEAN AIR ACT: CAA '90 Listed

HA WASTE NUMBER: U043,D043,D001

ERCLA REF: Not listed

DESIGNATION: X 1 pound (0.454 kg) CERCLA

RA TPQ VALUE: Not listed

RA Sect. 312

categories:

Acute toxicity: adverse effect to target organs.
 Chronic toxicity: carcinogen
 Chronic toxicity: adverse effect to target organ
 after long period of exposure.
 Chronic toxicity: mutagen.
 Chronic toxicity: reproductive toxin.
 Fire hazard: flammable.
 Sudden pressure: compressed gases.
 Reactive hazard: unstable/reactive.
 Acute toxicity: Toxic. LD50 > 50 and <= 500
 mg/kg (oral rat).

STED IN SARA Sect 313: Yes

minimum CONCENTRATION: 0.1 percent

UNITED STATES POSTAL SERVICE MAILABILITY:

Hazard class: Not given

Mailability: Nonmailable

Max per parcel: 0

NFPA CODES:

HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (4) This material forms readily ignitable mixtures in air.
REACTIVITY (YELLOW): (1) Normally stable, but may become unstable at elevated temperature and pressures.
SPECIAL : Unspecified

----- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON -----

ACGIH TLV list "Threshold Limit Values for 1989-1990"
ATSDR Toxicology Profile available (NTIS** PB/90/103870/AS)
California OSHA Carcinogens List.
California Assembly Bill 1803 Well Monitoring Chemicals.
California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
California Assembly Bill 1807 Toxic Air Contaminants.
California Proposition 65 Carcinogen List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 111 List.
Clean Air Act Section 112 Hazardous Air Pollutants List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
DOT Hazardous Materials Table. 49 CFR 172.101
EPA Carcinogen Assessment Group List
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Known carcinogen (ACGIH). "Threshold Limit Values for 1989-1990"
Massachusetts Substance List.
National Toxicology Program (NTP) list of human carcinogens
New Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
New Jersey Right to Know Substance List. Listed as a carcinogen.
New Jersey Right to Know Substance List. Listed as a mutagen.
NSA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
NSA Process Safety Rule chemical with a TQ. Effective May 26, 1992
Pennsylvania Hazardous Substance List
RCRA Hazardous Constituents for Ground Water Monitoring. Ap'dx IX to 40 CFR 264
RCRA Hazardous Waste
RCRA Toxicity Characteristics (TC) list dated March 29, 1990
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
VINYL CHLORIDE [75-01-4]
Washington State Discarded Chemical Products List, November 17, 1989
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

----- TOXICITY DATA -----

SHORT TERM TOXICITY: INHALATION: exposure at 8,000 ppm for 5 minutes can cause a feeling of intoxication, tiredness, drowsiness, abdominal pain, numbness and tingling in fingers and toes, pains in joints, coughing, sneezing, irritability and loss of appetite and weight. SKIN: contact with liquid may cause frostbite; contact with vapor may cause irritation and rash. absorption is possible through the skin. Eyes: can cause severe and immediate irritation. INGESTION: none found.(NYDH)

LONG TERM TOXICITY: may cause club-like swelling and shortening of finger tips. skin may become thickened and stiff with coarse, whitish patches. bones and joints of arms and legs may suffer damage. liver and spleen damage may occur. not all symptoms disappear after exposure stops. vinyl chloride has caused liver cancer in occupationally exposed individuals.(NYDH)

TARGET ORGANS: skin, eyes, mucous membranes, nervous system, liver, kidneys.

SYMPTOMS: INHALATION: high concentrations cause dizziness, anesthesia, lung irritation. SKIN: may cause frostbite; phenol inhibitor may be absorbed through skin if large amounts of liquid evaporate. Source: CHRIS

OSHA IDLH: Unknown

OSHA REL: Potential occupational carcinogen (use 1910.1017)

OSHA TLV: TLV = 5ppm Confirmed human carcinogen (A1)

OSHA STEL: Not listed

OSHA PEL: Final Rule Limits:
TWA = 1 ppm
CEILING = 5 ppm
CONSULT 29CFR 1910.1017

ADDITIONAL INFORMATION: Carcinogenic working material without MAK
Capable of inducing malignant tumors as shown by experience with humans.

IS CARCINOGEN?: Y STATUS: See below

REFERENCES:
HUMAN POSITIVE IARC** 19,377,79
ANIMAL POSITIVE IARC** 7,291,74
HUMAN SUSPECTED IARC** 7,291,74
ANIMAL POSITIVE IARC** 19,377,79
HUMAN POSITIVE IARC** 28,151,82

IS CARCINOGEN LISTS: IARC: Carcinogen as defined by

IARC as carcinogenic to humans,
with sufficient epidemiological
evidence.

MAK: Capable of inducing malignant
tumors as shown by experience in
humans.

NIOSH: Carcinogen defined by NIOSH
with no further categorization.

NTP: Carcinogen defined by NTP as
known to be carcinogenic, with
evidence from human studies.

ACGIH: Carcinogen defined by ACGIH
TLV Committee as a confirmed human
carcinogen, recognized to have
carcinogenic or cocarcinogenic
potential.

OSHA: Cancer suspect

LD50 value: orl-rat LD50:500 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

 orl-rat LD50:500 mg/kg
 ihl-rat LC50:18 pph/15M
 ihl-mam LCLo:200 ppm/18M

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):

 This chemical is a mammalian reproductive toxin.

EPRODUCTIVE TOXICITY DATA (1992 RTECS)

 ihl-man TCLo:30 mg/m3 (5Y male) GTPZAB 24(5),28,80
 PATERNAL EFFECTS
 Spermatogenesis

 ihl-rat TCLo:100 ppm/6H (26W male) EESADV 10,281,85
 PATERNAL EFFECTS
 Testes,epididymis,sperm duct

 ihl-rat TCLo:500 ppm/7H (6-15D preg) TXAPA9 33,134,75
 EFFECTS ON EMBRYO OR FETUS
 Fetotoxicity(except death,e.g.,stunted fetus)

 ihl-rat TCLo:1500 ppm/24H (1-9D preg) TXCYAC 11,45,78
 EFFECTS ON FERTILITY
 Post-implantation mortality

 ihl-rat TCLo:500 ppm/7H (6-15D preg) EVHPAZ 41,171,81
 EFFECTS ON EMBRYO OR FETUS
 Fetotoxicity(except death,e.g.,stunted fetus)
 SPECIFIC DEVELOPMENTAL ABNORMALITIES

Musculoskeletal system

ihl-rat TCLo:250 ppm/6H (55D pre) JTEHD6 3,965,77

EFFECTS ON FERTILITY

Female fertility index

ihl-mus TCLo:30000 ppm/6H (5D male) EVHPAZ 21,71,77

EFFECTS ON FERTILITY

Pre-implantation mortality

ihl-mus TCLo:500 ppm/7H (6-15D preg) EVHPAZ 41,171,81

EFFECTS ON EMBRYO OR FETUS

Fetotoxicity(except death,e.g.,stunted fetus)

SPECIFIC DEVELOPMENTAL ABNORMALITIES

Musculoskeletal system

SIGNIFICANT

SK LEVEL(Ca P65): 0.3 micrograms/day

----- PROTECTION AND FIRST AID -----

PROTECTION SUGGESTED

FROM THE CHRIS MANUAL:

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)

VINYL CHLORIDE

Unknown, or above 3600 ppm: Open-circuit, self-contained breathing apparatus, pressure demand type, with full facepiece.

At over 3600 ppm: Combination type C supplied air respirator, pressure demand type, with full or half facepiece, and auxiliary self-contained air supply; or

At over 1000 ppm: Combination type, supplied air respirator continuous flow type, with full or half facepiece, and auxiliary self-contained air supply. / Type C, Supplied air respirator, continuous flow type, with full or half facepiece, helmet or hood.

At over 100 ppm: (A) Combination type C supplied air respirator demand type; with full facepiece, and auxiliary self-contained air supply; or

(B) Open-circuit self-contained breathing apparatus with full facepiece, demand mode; or (C) Type C supplied air respirator, demand type, with full facepiece.

At over 25 ppm: (A) A powered air-purifying respirator with hood, helmet, full or half facepiece, and a canister which provides a service life of at least 4 hours for concentrations of vinyl chloride up to 25 ppm, or (B) Gas mask, front- or back-mounted canister which provides a service life of at least 4 hours for concentrations of vinyl chloride up to 25 ppm.

At over 10 ppm: (A) Combination type C supplied-air respirator, demand type, with half facepiece, and auxiliary self-contained air supply; or (B) Type C supplied-air respirator, demand type, with half facepiece; or (C) Any chemical cartridge respirator with an organic vapor cartridge which provides a service life of at least 1 hour for concentrations of vinyl chloride up to 10 ppm.

FIRST AID SOURCE: CT HCDB

EYE: None given

SKIN: None given

INHALATION: move to fresh air, keep quiet and warm, call doctor, artificial respirator.

INGESTION: None given

FIRST AID SOURCE: CHRIS Manual 1991

INHALATION: remove patient to fresh air and keep him quiet and warm; call a doctor; give artificial respiration if breathing stops.

EYES AND

SKIN: flush with plenty of water for at least 15 min.; for eyes, get medical attention; remove contaminated clothing.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of frostbite, thaw frosted parts with water. Keep victim quiet and maintain normal body temperature.

----- INITIAL INCIDENT RESPONSE -----

FIRE EXTINGUISHMENT: For small fires use dry chemical or carbon dioxide. For large fires stop flow of gas. Cool exposed containers with water. CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).

DOT SHIPPING NAME: Vinyl chloride, inhibited

DOT ID NUMBER: UN1086

TRG90

GUIDE 17

* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION

Extremely flammable.

May be ignited by heat, sparks and flames.

Vapors may travel to a source of ignition and flash back.

Container may explode violently in heat of fire.

Vapor explosion hazard indoors, outdoors or in sewers.

*HEALTH HAZARDS

May be poisonous if inhaled.

Contact may cause burns to skin and eyes.

Vapors may cause dizziness or suffocation.

Contact with liquid may cause frostbite.

Fire may produce irritating or poisonous gases.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind, out of low areas, and ventilate closed spaces before entering.

Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.

Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire.

CALL CHEMTREC AT 1-800-424-9300 AS SOON AS POSSIBLE, especially if there is no local hazardous team available.

IRE

Let tank, tank car or tank truck burn unless leak can be stopped; with smaller tanks or cylinders, extinguish/isolate from other flammables.

Small Fires: Dry chemical or CO2.

Large Fires: Water spray, fog or regular foam.

Move container from fire area if you can do it without risk.

For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

Cool container with water using unmanned device until well after fire is out.

PILL OR LEAK

Shut off ignition sources; no flares, smoking or flames in hazard area.

Stop leak if you can do it without risk.

Water spray may reduce vapors; but it may not prevent ignition in closed spaces.

Isolate area until gas has dispersed.

IRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.

In case of frostbite, thaw frosted parts with water.

Keep victim quiet and maintain normal body temperature.

DISCLAIMER: The data shown above on this chemical represents a best effort on the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the guidelines and limitations of the user's CHEMTOX license agreement.

The COMPILERS of the CHEMTOX database shall not be held liable for inaccuracies or omissions within this database, or in any of its printed or displayed output forms.

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LAST UPDATE OF THIS RECORD: 06/03/93

NAME: ZINC
SYNONYMS: BLUE POWDER; C.I. 77945; C.I. PIGMENT BLACK 16; C.I. PIGMENT METAL 6; EMANAY ZINC DUST; GRANULAR ZINC; JASAD; ZINC DUST; ZINC POWDER
CAS: 7440-66-6 RTECS: ZG8600000
FORMULA: Zn MOL WT:
WLN: ZN
CHEMICAL CLASS: Metal

See other identifiers listed below under Regulations.

PROPERTIES

PHYSICAL DESCRIPTION: bluish-white, lustrous, metallic element.			
BOILING POINT:	1181.15 K	908 C	1666.4 F
MELTING POINT:	692.95 K	419.8 C	787.6 F
FLASH POINT:	NA		
AUTO IGNITION:	NA		
VAPOR PRESSURE:	1mm @ 487		
WATER SOLUBILITY:	na		
DENSITY:	na		
VAPOR DENSITY:	No data		
SPECIFIC GRAVITY:	7.14 @ 25		
WATER SOLUBILITY:	7.14 g/cc or 66.402 lb/gal		
INCOMPATIBILITIES:	acids, strong bases, chlorine, bromine		
REACTIVITY WITH WATER:	No data on water reactivity		
REACTIVITY WITH COMMON MATERIALS:	No data		
STABILITY DURING TRANSPORT:	No Data		
NEUTRALIZING AGENTS:	No data		
POLYMERIZATION POSSIBILITIES:	No data		
TOXIC FIRE GASES:	None reported other than possible unburned vapors		
ODOR DETECTED AT (ppm):	Unknown		
ODOR DESCRIPTION:	No data		
ODOR % ODOR DETECTION:	No data		

REGULATIONS

DOT hazard class: 9 CLASS 9
DOT guide: 31
Identification number: UN3077
DOT shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCES, SOLID,
N.O.S. (ZINC)

cking group: III
bel(s) required: CLASS 9
ecial provisions: 8, B54
ckaging exceptions: 173.155
n bulk packaging: 173.213
lk packaging: 173.240
antity limitations-
ssenger air/rail: NONE
rgo aircraft only: NONE
ssel stowage: A
her stowage provisions:

CC NUMBER: Not listed

LEAN WATER ACT Sect.307:Yes

LEAN WATER ACT Sect.311:No

LEAN AIR ACT: Not listed

A WASTE NUMBER: None

RCLA REF: Y

DESIGNATION: C 1000 pounds (454 kg) CERCLA for pieces of solid me
with diameter less than 100 micrometers (0.004
inches).

RA TPQ VALUE: Not listed

RA Sect. 312

categories:

Acute toxicity: Irritant

Chronic toxicity: adverse effect to target organ
after long period of exposure.

STED IN SARA Sect 313: Yes

minimus CONCENTRATION: 1.0 percent

ITED STATED POSTAL SERVICE MAILABILITY:

ot given

PA CODES:

HEALTH HAZARD (BLUE): Unspecified

FLAMMABILITY (RED) : Unspecified

REACTIVITY (YELLOW): Unspecified

SPECIAL : Unspecified

----- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON -----

ESDR Toxicology Profile available (NTIS** PB/90/171414/AS)

California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.

lean Water Act Section 307 Priority Pollutants

PA TSCA Chemical Inventory List 1986

PA TSCA Chemical Inventory List 1989

PA TSCA Chemical Inventory List 1990

PA TSCA Chemical Inventory List 1992

PA TSCA Test Submission (TSCATS) Database - April 1990

EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
Pennsylvania Hazardous Substance List
SARA Section 313 Toxic Chemicals List
ZINC [7440-66-6]

----- TOXICITY DATA -----

SHORT TERM TOXICITY: Unknown

LONG TERM TOXICITY: unknown

TARGET ORGANS: skin

SYMPTOMS: INHALATION OF FUMES MAY RESULT IN SWEET TASTE, THROAT DRYNESS, COUGH, WEAKNESS, GENERALIZED ACHING, CHILLS, FEVER, NAUSEA, VOMITING; A HUMAN SKIN IRRITANT AND PUL-PURE ZINC POWDER, DUST, FUME IS RELATIVELY NON-TOXIC TO HUMANS VIA IRRITATION OR INHALATION DIFFICULTY ARISES FROM OXIDATION OF ZINC FUMES PRIOR TO INHALATION OR PRESENCE OF IMPURITIES SUCH AS LEAD, ARSENIC, CADMIUM, ANTIMONY Source: MI; SAX

CONC IDLH: Unknown

NIOSH REL: Not given

ACGIH TLV: Not listed

ACGIH STEL: Not listed

OSHA PEL: Not in Table Z-1-A

MAK INFORMATION: Not listed

ARCINOGEN?: N STATUS: See below

ARCINOGEN LISTS:

IARC: Not listed
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

ihl-hmn TCLo:124 mg/m3/50M AHYGAJ 72,358,10
LUNGS, THORAX, OR RESPIRATION
Cough
LUNGS, THORAX, OR RESPIRATION
Dyspnea
SKIN AND APPENDAGES

Other
Sweating

50 value: No LD50 in RTECS 1992

IRITATION DATA: (Source: NIOSH RTECS 1992)

skn-hmn 300 ug/3D-I MLD

productive toxicity (1992 RTECS):

This chemical has no known mammalian reproductive toxicity.

PRODUCTIVE TOXICITY DATA (1992 RTECS)

----- EPA's IRIS DATA SUMMARY -----
Zinc and Compounds; CASRN 7440-66-6 (04/01/92)

I. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Chemical Name -- Zinc and Compounds

SRN -- 7440-66-6

Last Revised -- 02/01/91

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L in drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

_II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- D; not classifiable as to human carcinogenicity

Justification -- Based on inadequate evidence in humans and animals.

_II.A.2. HUMAN CARCINOGENICITY DATA

Inadequate. There are no reports on the possible carcinogenicity of zinc and compounds per se in humans. Case studies have been used to evaluate the effects of zinc administered for therapeutic reasons. There are reports which compare zinc levels in normal and cancerous tissue. Studies of occupational exposure to zinc compounds have also been conducted, but have limited value because they do not correlate exposure with cancer risk.

Case reports of chronic therapeutic exposure for approximately 2 years of two patients, a 59-year-old female and a 26-year-old homozygous sickle-cell male, to 100-150 mg/day zinc as zinc sulfate or zinc acetate, respectively, have reported a profound anemia associated with hypochromic microcytosis and hypochromemia (Porter et al., 1977; Prasad et al., 1978). The conditions were corrected by copper supplementation and, in one case, withdrawal of zinc.

Habib et al. (1976) reported that average zinc concentrations in normal and hypertrophic prostate tissues were similar, approximately 6.8 $\mu\text{mol/g}$, but the average zinc concentration was lower in carcinomatous prostate tissues (2.6 $\mu\text{mol/g}$). These tissue samples were obtained as follows: normal prostate tissues were obtained at autopsy from 9 men 25-58 years old (average age 36); and both hyperplastic and carcinomatous prostate tissues were obtained from the biopsies of 23 men 58-87 years old (average age 70) and from 9 men 64-91 years old (average age 73), respectively. Several other studies have also shown lower average zinc concentrations in cancerous vs. normal or hypertrophic prostate tissue (U.S. EPA, 1987). NRC (1978) and U.S. EPA (1987) have reviewed other studies which have noted both high and low zinc levels in other cancerous and noncancerous tissues with no definite pattern. From these studies it could not be concluded whether zinc was a carcinogen.

Several occupational studies have been conducted on workers exposed to zinc compounds (Batchelor et al., 1926; Chmielewski et al., 1974a,b; Bobrishchev-Pushkin et al., 1977). No increase in the incidence of cancer was noted; however, the studies were designed to evaluate other endpoints and did not specifically address cancer. Other symptoms such as slight leukocytosis, occurrences of metal fume fever, respiratory disease and hypocalcemia were some of the findings noted in exposed workers. Batchelor et al. (1926) extensively investigated workers exposed to zinc in a smelter. A total of 24 workers whose exposure ranged from 2-35.5 years were selected. In most work areas the mean zinc concentrations were generally below 35 mg/cu.m, except in the zinc dust plant where concentrations of up to 130 mg/cu.m were measured. The average level of zinc in whole blood of the 24 exposed workers was 458 $\mu\text{g}/100\text{ mL}$, compared with 387 $\mu\text{g}/100\text{ mL}$ in 10 control measurements. No information was given about the control subjects. Klucik and Koprda (1979) found that exposure levels to zinc oxide dust in a zinc oxide factory were on average 0.5 mg/cu.m for zinc melters and 2.44-7.15 mg/cu.m for zinc oxide packers; it was not indicated how these values were obtained. Chmielewski et al. (1974a,b) examined a group of workers who were exposed to zinc oxide in a shipyard; this included 20 ship smiths, 20 electric welders, 20 ship's pipeline fitters, and 20 zincifying workers. High concentrations of zinc oxide were found at the stands of the electric welders, who worked in containers (maximum 58 mg/cu.m, mean 18 mg/cu.m), and the ship smiths, who worked in a superstructure (maximum 50 mg/cu.m, mean 12 mg/cu.m). These workers were also exposed to other hazardous compounds, such as nitrogen oxides. Bobrishchev-Pushkin et al. (1977) studied 1018 workers in the casting

ops of three copper alloy production facilities in the USSR. Four hundred and fifty-one workers from the rolling shops were used as controls. The average level of zinc oxide exposure in the casting shop was 2.1 mg/cu.m (range of 0.2-5.1 mg/cu.m), well below the USSR's maximally allowable concentration of 6 mg/cu.m. Workers were also exposed to other metals such as copper, lead and nickel.

II.A.3. ANIMAL CARCINOGENICITY DATA

Inadequate. In a 1-year study, an unspecified number of newborn Chesteratty stock mice (sex not reported) were administered 0, 1000, or 5000 ppm zinc (approximately 0, 170, or 850 mg/kg/day) as zinc sulfate in drinking water (Walters and Roe, 1965). A separate group of mice received zinc oleate in the diet at an initial dose of 5000 ppm zinc; this dose was reduced to 2500 ppm after 3 months and to 1250 ppm after an additional 3 months because of mortality due to anemia. An epidemic of ectromelia caused the deaths of several mice during the first 8 weeks; consequently, additional control and test-diet groups were established. There was no difference in body weight in between control and treated groups, except the dietary zinc group which became anemic. Survival was not reported in treated compared with control groups.

An apparent increase in the incidence of hepatomas was observed in treated mice surviving for 45 weeks or longer relative to controls (original and placement mice pooled). The hepatoma incidence in the control, low-dose drinking water, high-dose drinking water, and test-diet group was 3/24 (12.5%), 3/28 (10.7%), 3/22 (13.6%), and 7/23 (30.4%), respectively. Incidence of malignant lymphoma in the control, low-dose drinking water, high-dose drinking water, and test-diet groups was 3/24 (12.5%), 4/28 (14.3%), 2/22 (9.1%), and 2/23 (8.7%), respectively. Incidence of lung adenoma in the control, low-dose drinking water, high-dose drinking water, and test-diet groups was 10/24 (41.7%), 9/28 (32.1%), 5/22 (22.7%), and 9/23 (39.1%), respectively. None of these were significantly elevated in a statistical analysis of this data performed by the EPA. In a 14-month study conducted with 150 C3H mice (sex not reported), administration of 500 mg/L zinc sulfate (approximately 100 mg/kg/day) in the drinking water resulted in hypertrophy of the adrenal cortex and pancreatic islets (Aughey et al., 1977). No tumors were noted; however, only the adrenal, pancreas and adenohypophysis were examined. Accurate consumption data could not be obtained due to spillage during drinking. No instances of adrenal or pancreatic hypertrophy were seen in a control group (number of animals not stated) that received only distilled water.

After an intratesticular injection of zinc, Guthrie observed seasonally-related testicular tumors in fowl (Guthrie, 1964) but no tumors in rats (Guthrie, 1956). Guthrie (1964) administered zinc chloride, zinc acetate or zinc stearate to groups of white leghorn chickens by intratesticular injection (approximately 0.01 g/injection); groups of chickens were sacrificed from 3 weeks to 11 months. Eight of the 111 chickens injected with zinc chloride in January and February developed testicular testoma, while none of the 48 chickens injected with zinc chloride in March developed tumors. None of the

36 chickens injected with zinc acetate in March and none of the 14 chickens injected with zinc stearate in January and February developed tumors; no conclusions about the carcinogenicity of these two compounds could be made because an insufficient number of chickens were tested. No control group was described.

Guthrie injected 0.15-0.20 mL of 10% zinc sulfate into the testis of nineteen 4-month-old rats and 0.15 mL of 5% zinc chloride into the testis of twenty-nine 3-month-old rats (strain not specified) (Guthrie 1956). No testicular tumors were observed in either group at sacrifice 15 months after injection. No controls were described. Riviere et al. (1959) injected 5% zinc chloride in distilled water into the testicles of 100 Wistar rats. The rats were subdivided into several groups; some rats were unilaterally castrated and some rats received an injection of 200 units serum gonadotrophin and a subcutaneous implantation of a 25 mg pellet of distilbene or 100 mg testosterone. The number of rats in each of the four groups (unilateral castration +/- hormone treatment and untreated +/- hormone treatment) was not stated. No control group was described. Testicular tumors (including interstitial tumors, a seminoma and an embryoma) became apparent 15 months after inoculation (tumor incidence not specified). There are no specific data on the effects of hormones in this experiment.

Halme (1961) exposed tumor-resistant and tumor-susceptible strains of mice to zinc in drinking water. In a 3-year, five-generation study, zinc chloride was added to the water of tumor-resistant mice (strain not specified); the groups received 0, 10, 20, 50, 100, or 200 mg Zn/L. The spontaneous tumor frequency for this strain of mice was 0.0004%. The tumor frequencies in the generations were: F0=0.8%, F1=3.5%, F1 and F2=7.6% and F3 and F4=25.7%. Most of the tumors occurred in the 10 and 20 mg Zn dose groups. No statistical analyses and no individual tumor-type data were reported. In the tumor-susceptible mice, strains C3H and A/Sn received 10-29 mg Zn/L in their drinking water for 2 years; 33/76 tumors were observed in the C3H strain (31 in females) and 24/74 tumors were observed in the A/Sn strain (20 in females). Most of the tumors were adenocarcinomas. The numbers of specific tumor types were not reported. The tumor frequencies (43.4% for C3H and 32.4% for A/Sn both sexes combined) were higher than the spontaneous frequency (15% for each strain), although no statistical analyses were reported.

II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

In a short-term, in vivo assay, Stoner et al. (1976) injected strain A/Strong mice (20/sex/dose) intraperitoneally with zinc acetate 3 times/week for a total of 24 injections (total doses were 72, 180, or 360 mg/kg). Controls (20/sex/group) consisted of an untreated group, a vehicle control group administered 24 injections of saline and a positive control group administered a single injection of urethan (20 mg/mouse). Mice were sacrificed 30 weeks after the first injection; survival was comparable for all groups. There was no increase in number of lung tumors per mouse in treated animals relative to the pooled controls. While four thymomas were observed in zinc acetate-treated groups and none in controls, the occurrence of these tumors was not statistically significantly elevated.

Urine samples from subjects occupationally exposed in the rubber industry a variety of compounds, including zinc oxide, were not found to be mutagenic in the microtitre fluctuation assay with *Salmonella typhimurium* strains TA1535, TA98 and TA100 (Crebelli et al., 1985).

The results of short-term genotoxicity assays for zinc are equivocal. Zinc acetate and/or zinc 2,4-pentanedione have been analyzed in four short-term mutagenicity assays (Thompson et al., 1989). In the *Salmonella* assay (with or without hepatic homogenates), zinc acetate was not mutagenic over a dose range of 50-7200 ug/plate but zinc 2,4-pentanedione was mutagenic to strains TA1538 and TA98 at 400 ug/plate. The addition of hepatic homogenates diminished this response in a dose-dependent manner. In the mouse lymphoma assay, zinc acetate gave a dose-dependent positive response with or without metabolic activation; the mutation frequency doubled at 10 ug/mL. In the CHO *in vitro* cytogenetic assay, zinc acetate gave a dose-dependent positive response with or without metabolic activation, but the presence of hepatic homogenates decreased the clastogenic effect. Neither zinc acetate nor zinc 2,4-pentanedione were positive in the unscheduled DNA synthesis assay in rat hepatocytes over a dose range of 10-1000 ug/mL.

Zinc chloride is reported to be positive in the *Salmonella* assay (Kalinina et al., 1977), negative in the mouse lymphoma assay (Amacher and Paillet, 1980), and a weak clastogen in cultured human lymphocytes (Deknuddt and Minatti, 1978). Zinc sulfate is reported to be not mutagenic in the *Salmonella* assay (Gocke et al., 1981), and zinc acetate is reported to not induce chromosomal aberrations in cultured human lymphocytes (Gasiorek and Uehlinger, 1981). Crebelli et al. (1985) found zinc oxide (99% purity) (1000-5000 ug/plate) to be not mutagenic for *Salmonella* in the reversion assay.

Responses in mutagenicity assays are thought to depend on the form (e.g., organic or inorganic salt) of the zinc tested. For example, inorganic salts tend to dissociate and the zinc becomes bound with culture media constituents. Salts that dissociate less readily tend to be transported into the cell and are postulated to cause a positive response (Thompson et al., 1989). Zinc is an essential trace element involved in numerous biological functions including growth, taste and spermatogenesis. It is a cofactor for several enzymes such as those involved in the metabolism of proteins and nucleic acids. Zinc may be a modifier of the carcinogenic response; zinc deficiency or excessively high levels of zinc may enhance susceptibility to carcinogenesis, whereas supplementation with low to moderate levels of zinc may offer protection (Woolf et al., 1988). Zinc deficiency enhanced carcinomas of the esophagus induced by methylbenzyl nitrosoamine (Fong et al., 1978) but retarded the development of cancer of the oral cavity induced by 4-nitroquinoline-N-oxide (Wallenius et al., 1979). In a study that examined both zinc deficiency and supplementation, Mathur (1979) found that animals with a deficient diet (5.9 mg/kg) and animals diet supplemented with excessively high levels of zinc in the diet (200-260 mg/kg) had fully developed carcinomas of the palatal mucosa. While the rats were on the specific diets, the palatal mucosa was treated with 4 nitroquinoline 3 times/week for 20 weeks. In the zinc deficient group 2/25 rats developed cancer of the palatal mucosa; 2/25 rats in the excessive zinc group also developed this form of cancer. Animals

supplemented with moderate levels of zinc in the diet (50 mg/kg) developed only moderate dysplasia. Thus, zinc's modifying effect on carcinogenesis may be dose-dependent.

II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

None.

II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

None.

II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

II.D.1. EPA DOCUMENTATION

U.S. EPA. 1980. Ambient Water Quality Criteria for Zinc. Prepared by the Office of Water Regulations and Standards, Washington, DC. EPA 440/5-80-079.

U.S. EPA. 1984. Health Effects Assessment for Zinc (and Compounds). Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Emergency and Remedial Response, Washington, DC.

U.S. EPA. 1987. Summary Review of the Health Effects Associated with Zinc and Zinc Oxide. Health Issue Assessment. Environmental Criteria and Assessment Office, Research Triangle Park, NC. EPA/600/8-87/022F.

U.S. EPA. 1988. Ambient Water Quality Criteria Document Addendum for Zinc. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Water Regulations and Standards, Washington, DC.

II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The 1984 Health Effects Assessment for Zinc (and compounds), the 1987 Health Issue Assessment and the 1980 and 1988 Ambient Water Quality Criteria Documents have received Office of Health Effects Assessment review.

ency Work Group Review: 11/08/89, 06/15/90

rification Date: 06/15/90

II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

ta S. Schoeny / ORD -- (513)569-7544 / FTS 684-7544

----- PROTECTION AND FIRST AID -----

OTECTION SUGGESTED
OM THE CHRIS MANUAL:

RST AID SOURCE: DOT Emergency Response Guide 1990.

case of contact with material, immediately flush eyes with running
ter for at least 15 minutes. Wash skin with soap and water. Remove and
olate contaminated clothing and shoes at the site.

----- INITIAL INCIDENT RESPONSE -----

Department of Transportation Guide to Hazardous Materials Transport
formation - Publication DOT 5800.5 (1990).

T SHIPPING NAME: ENVIRONMENTALLY HAZARDOUS SUBSTANCES, SOLID, N.O.S. (ZINC)

T ID NUMBER: UN3077

G90

GUIDE 31

* POTENTIAL HAZARDS *

IRE OR EXPLOSION

Some of these materials may burn, but none of them ignites readily.

HEALTH HAZARDS

Contact may cause burns to skin and eyes.

Fire may produce irritating or poisonous gases.

Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.

Positive pressure self-contained breathing apparatus (SCBA) and structural
firefighters' protective clothing will provide limited protection.

CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water
pollution occurs, notify the appropriate authorities.

IRE

Small Fires: Dry chemical, CO2, water spray or regular foam.

Large Fires: Water spray, fog or regular foam.

Move container from fire area if you can do it without risk.
Do not scatter spilled material with high-pressure water streams.
Dike fire-control water for later disposal.

***SPILL OR LEAK**

Stop leak if you can do it without risk.

Small Dry Spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.

Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.

Large Spills: Dike far ahead of liquid spill for later disposal.

Cover powder spill with plastic sheet or tarp to minimize spreading.

***FIRST AID**

In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.

Remove and isolate contaminated clothing and shoes at the site.

DISCLAIMER: The data shown above on this chemical represents a best effort on the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the guidelines and limitations of the user's CHEMTOX license agreement. The COMPILERS of the CHEMTOX database shall not be held liable for inaccuracies or omissions within this database, or in any of its printed or displayed output forms.

N

SUBCONTRACTOR'S VEHICLE &
DRILL RIG SAFETY PLAN

VEHICLE AND RIG SAFETY PLAN

2. Governmental Regulations

All local, state and federal regulations or restrictions, currently in effect or effected in the future, take precedence over the recommendations and suggestions which follow. Government regulations will vary from country to country and from state to state.

3. The Safety Supervisor

The safety supervisor for the drill crew will in most cases be the drill rig operator.

- The safety supervisor should consider the "responsibility" for safety and the "authority" to enforce safety to be a matter of first importance.

- The safety supervisor should be the leader in using proper personal safety gear and set an example in following the rules that are being enforced on others.

- The safety supervisor should enforce the use of proper personal protective safety equipment and take appropriate corrective action when proper personal protective safety equipment is not being used.

- The safety supervisor should understand that proper maintenance of tools and equipment and general "housekeeping" on the drill rig will provide the environment to promote and enforce safety.

- Before drilling is started with a particular drill, the safety supervisor must be assured that the operator (who may be the safety supervisor) has had adequate training and is thoroughly familiar with the drill rig, its controls and its capabilities.

- The safety supervisor should inspect the drill rig at least daily for structural damage, loose bolts and nuts, proper tension in chain drives, loose or missing guards or protective covers, fluid leaks, damaged hoses and/or damaged pressure gauges and pressure relief valves.

- The safety supervisor should check and test all safety devices such as emergency shut-down switches at least daily and preferably at the start of a drilling shift. Drilling should not be permitted until all emergency shut-down and warning systems are working correctly. Do not wire around, bypass or remove an emergency device.

- The safety supervisor should check that all gauges, warning

lights and control levers are functioning properly and listen for unusual sounds on each starting of an engine.

- The safety supervisor should assure that all new drill rig workers are informed of safe operating practices on and around the drill rig and should provide each new drill rig worker with a copy of the organization's drilling operations safety manual, and when appropriate the drill rig manufacturer's operations and maintenance manual. The safety supervisor should assure that each new employee reads and understands the safety manual.



- The safety supervisor should carefully instruct a new worker in drilling safety and observe the new worker's progress towards understanding safe operating practices.

- The safety supervisor should observe the mental, emotional and physical capability of each worker to perform the assigned work in a proper and safe manner. The safety supervisor should dismiss any worker from the drill site whose mental and physical capabilities might cause injury to the worker or coworkers.

- The safety supervisor should assure that there is a first-aid kit on each drill rig and a fire extinguisher on each drill rig and on each additional vehicle and assure that they are properly maintained.

- The safety supervisor (and as many crew members as possible) should be well trained and capable of using first-aid kits, fire extinguishers and all other safety devices and equipment.

- The safety supervisor should maintain a list of addresses and telephone numbers of emergency assistance units (ambulance services, police, hospitals, etc.) and inform other members of the drill crew of the existence and location of the list.

4. Individual Protective Equipment

For most geotechnical, mineral and/or groundwater drilling projects, individual protective equipment should include a safety hat, safety shoes, safety glasses and close fitting gloves and clothing. The clothing of the individual drill rig worker is not generally considered protective equipment; however, your clothing should be close fitting but comfortable, without loose ends, straps, draw strings or belts or otherwise unfastened parts that might catch on some rotating or translating component of the drill rig. Rings and jewelry should not be worn during a work shift.

- **Safety Head Gear.** Safety hats (hard hats) should be worn by everyone working or visiting at or near a drilling site. All safety hats should meet the requirements of ANSI Z89.1. All safety hats should be kept clean and in good repair with the headband and crown straps properly adjusted for the individual drill rig worker or visitor.

- **Safety Shoes or Boots.** Safety shoes or boots should be worn by all drilling personnel and all visitors to the drill site that observe drilling operations within close proximity of the drill rig. All safety shoes or boots should meet the requirements of ANSI Z41.1

- **Gloves.** All drilling personnel should wear gloves for protection against cuts and abrasion which could occur while handling wire rope or cable and from contact with sharp edges and burrs on drill rods and other drilling or sampling tools. All gloves should be close fitting and not have large cuffs or loose ties which can catch on rotating or translating components of the drill rig.

- **Safety Glasses.** All drilling personnel should wear safety glasses. All safety glasses should meet the requirements of ANSI Z87.1.



- **Other Protective Equipment.** For some drilling operations, the environment or regulations may dictate that other protective equipment be used. The requirement for such equipment must be determined jointly by the management of the drilling organization and the safety supervisor. Such equipment might include face or ear protection or reflective clothing. Each drill rig worker should wear noise reducing ear protectors when appropriate. When drilling is performed in chemically or radiologically contaminated ground, special protective equipment and clothing may and probably will be required. The design and composition of the protective equipment and clothing should be determined as a joint effort of management and the client who requests the drilling services.

5. Housekeeping On And Around The Drill Rig

The first requirement for safe field operations is that the safety supervisor understands and fulfills the responsibility for maintenance and "housekeeping" on and around the drill rig.

- Suitable storage locations should be provided for all tools, materials and supplies so that tools, materials and supplies can be conveniently and safely handled without hitting or falling on a member of the drill crew or a visitor.
- Avoid storing or transporting tools, materials or supplies within or on the mast (derrick) of the drill rig.
- Pipe, drill rods, casing, augers and similar drilling tools should be orderly stacked on racks or sills to prevent spreading, rolling or sliding.
- Penetration or other driving hammers should be placed at a safe location on the ground or be secured to prevent movement when not in use.
- Work areas, platforms, walkways, scaffolding and other accessways should be kept free of materials, debris and obstructions and substances such as ice, grease or oil that could cause a surface to become slick or otherwise hazardous.
- Keep all controls, control linkages, warning and operation lights and lenses free of oil, grease and/or ice.
- Do not store gasoline in any portable container other than a non-sparking, red container with a flame arrester in the fill spout and having the word "gasoline" easily visible.

6. Maintenance Safety

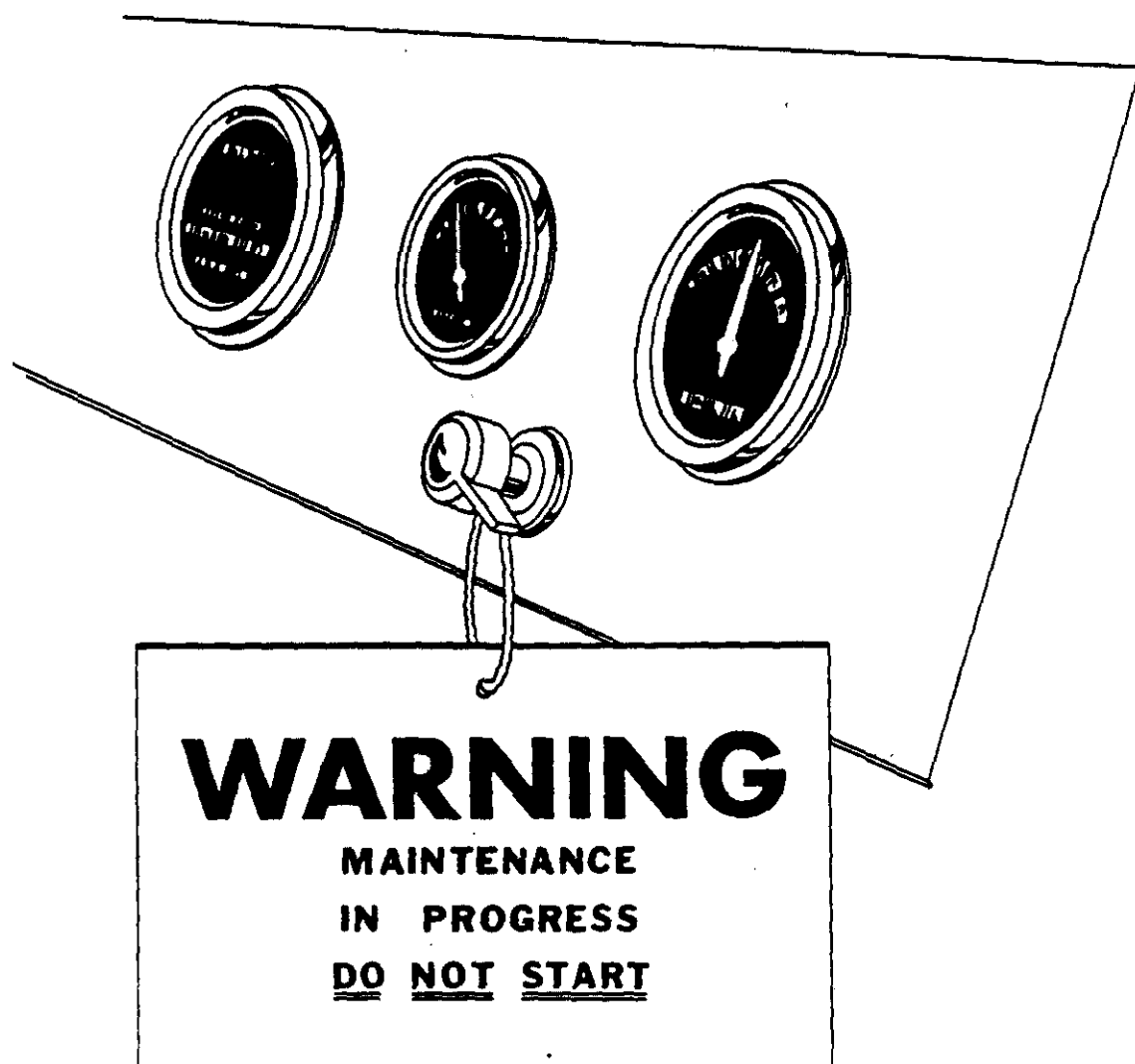
Good maintenance will make drilling operations safer. Also, maintenance should be performed safely.

- Wear safety glasses when performing maintenance on a drill rig or on drilling tools.
- Shut down the drill rig engine to make repairs or adjustments to a drill rig or to lubricate fittings (except repairs or adjustments that can only be made with the engine running). Take precautions to prevent accidental starting of an engine during maintenance by removing or tagging the ignition key.

- Always block the wheels or lower the leveling jacks or both and set hand brakes before working under a drill rig.

- When possible and appropriate, release all pressure on the hydraulic systems, the drilling fluid system and the air pressure systems of the drill rig prior to performing maintenance. In other words, reduce the drill rig and operating systems to a "zero energy state" before performing maintenance. Use extreme caution when opening drain plugs and radiator caps and other pressurized plugs and caps.

- Do not touch an engine or the exhaust system of an engine following its operation until the engine and exhaust system have had adequate time to cool.



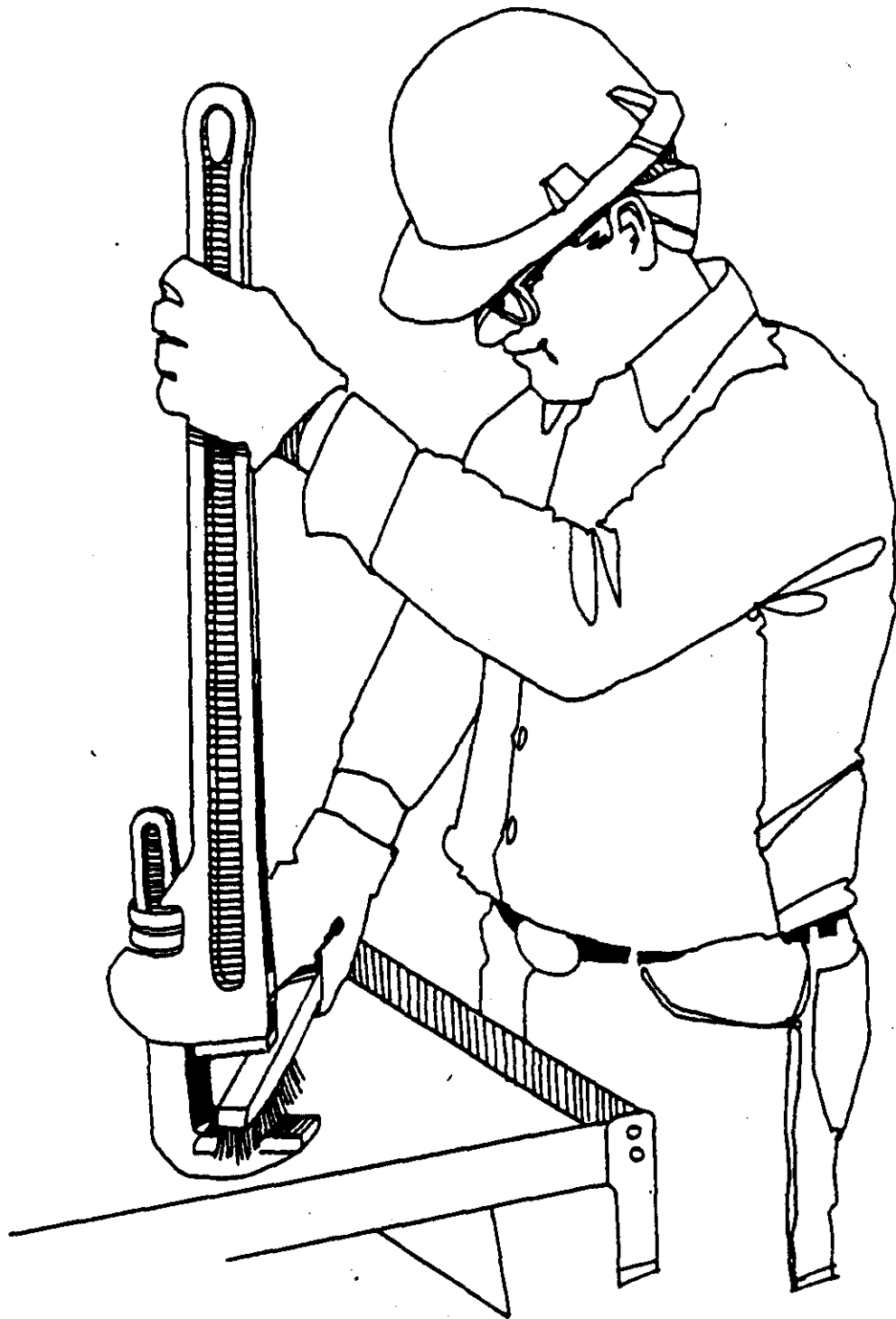
- Never weld or cut on or near a fuel tank.
- Do not use gasoline or other volatile or flammable liquids as a cleaning agent on or around a drill rig.
- Follow the manufacturer's recommendations for applying the proper quantity and quality of lubricants, hydraulic oils and/or coolants.

- Replace all caps, filler plugs, protective guards or panels and high pressure hose clamps and chains or cables that have been removed for maintenance before returning the drill rig to service.

7. Safe Use Of Hand Tools

There are almost an infinite number of hand tools that can be used on or around a drill rig and in repair shops and more than an equal number of instructions for proper use. "Use the tool for its intended purpose" is the most important rule. The following are a few specific and some general suggestions which apply to safe use of several hand tools that are often used on and around drill rigs.

- When a tool becomes damaged, either repair it before using it again or get rid of it.
- When using a hammer, any kind of hammer for any purpose, wear safety glasses and require all others around you to wear safety glasses.
- When using a chisel, any kind of chisel, for any purpose, wear safety glasses and require all others around you to wear safety glasses.
- Keep all tools cleaned and orderly stored when not in use.
- Use wrenches on nuts – don't use pliers on nuts.
- Use screwdrivers with blades that fit the screw slot.
- When using a wrench on a tight nut – first use some penetrating oil, use the largest wrench available that fits the nut, when possible pull on the wrench handle rather than pushing, and apply force to the wrench with both hands when possible and with both feet firmly placed. Don't push or pull with one or both feet on the drill rig or the side of a mud pit or some other blocking-off device. Always assume that you may lose your footing – check the place where you may fall for sharp objects.
- Keep all pipe wrenches clean and in good repair. The jaws of pipe wrenches should be wire brushed frequently to prevent an accumulation of dirt and grease which would otherwise build up and cause wrenches to slip.
- Never use pipe wrenches in place of a rod holding device.
- Replace hook and heel jaws when they become visibly worn.



- When breaking tool joints on the ground or on a drilling platform, position your hands so that your fingers will not be smashed between the wrench handle and the ground or the platform, should the wrench slip or the joint suddenly let go.

8. Clearing The Work Area

Prior to drilling, adequate site clearing and leveling should be performed to accommodate the drill rig and supplies and provide a

safe working area. Drilling should not be commenced when tree limbs, unstable ground or site obstructions cause unsafe tool handling conditions.

9. Start Up

- All drill rig personnel and visitors should be instructed to "stand clear" of the drill rig immediately prior to and during starting of an engine.
- Make sure all gear boxes are in neutral, all hoist levers are disengaged, all hydraulic levers are in the correct nonactuating positions and the cathead rope is not on the cathead before starting a drill rig engine.
- Start all engines according to the manufacturer's manual.

10. Safety During Drilling Operations

Safety requires the attention and cooperation of every worker and site visitor.

- Do not drive the drill rig from hole to hole with the mast (derrick) in the raised position.
- Before raising the mast (derrick) look up to check for overhead obstructions. (Refer to Section 11 on Overhead and Buried Utilities.)
- Before raising the mast (derrick), all drill rig personnel (with exception of the operator) and visitors should be cleared from the areas immediately to the rear and the sides of the mast. All drill rig personnel and visitors should be informed that the mast is being raised prior to raising it.
- Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig must be first leveled and stabilized with leveling jacks and/or solid cribbing. The drill rig should be releveled if it settles after initial set up. Lower the mast (derrick) only when the leveling jacks are down and do not raise the leveling jack pads until the mast (derrick) is lowered completely.
- Before starting drilling operations, secure and/or lock the mast (derrick) if required according to the drill manufacturer's recommendations.

- The operator of a drill rig should only operate a drill rig from the position of the controls. If the operator of the drill rig must leave the area of the controls, the operator should shift the transmission controlling the rotary drive into neutral and place the feed control lever in neutral. The operator should shut down the drill engine before leaving the vicinity of the drill.

- Throwing or dropping tools should not be permitted. All tools should be carefully passed by hand between personnel or a hoist line should be used.

- Do not consume alcoholic beverages or other depressants or chemical stimulants prior to starting work on a drill rig or while on the job.

- If it is necessary to drill within an enclosed area, make certain that exhaust fumes are conducted out of the area. Exhaust fumes can be toxic and some cannot be detected by smell.

- Clean mud and grease from your boots before mounting a drill platform and use hand holds and railings. Watch for slippery ground when dismounting from the platform.

- During freezing weather, do not touch any metal parts of the drill rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.

- All air and water lines and pumps should be drained when not in use if freezing weather is expected.

- All unattended boreholes must be adequately covered or otherwise protected to prevent drill rig personnel, site visitors or animals from stepping or falling into the hole. All open boreholes should be covered, protected or backfilled adequately and according to local or state regulations on completion of the drilling project.

- "Horsing around" within the vicinity of the drill rig and tool and supply storage areas should never be allowed, even when the drill rig is shut down.

- When using a ladder on a drill rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending or descending. Do not attempt to use one or both hands to carry a tool while on a ladder. Use a hoist line and a tool "bucket" or a safety hook to raise or lower hand tools.

An elevated derrick platform should be used with the following precautions:

- When working on a derrick platform, use a safety belt and a lifeline. The safety belt should be at least 4 in. (100 mm) wide and should fit snugly but comfortably. The lifeline, when attached to the derrick, should be less than 6 ft. (2 m) long. The safety belt and lifeline should be strong enough to withstand the dynamic force of a 250 lb. (115 kg) weight (contained within the belt) falling 6 ft. (2 m).

- When climbing to a derrick platform that is higher than 20 ft. (6 m), a safety climbing device should be used.

- When a rig worker is on a derrick platform, the lifeline should be fastened to the derrick just above the derrick platform and to a structural member that is not attached to the platform or to other lines or cables supporting the platform.

- When a rig worker first arrives at a derrick platform, the platform should immediately be inspected for broken members, loose connections and loose tools or other loose materials.

- Tools should be securely attached to the platform with safety lines. Do not attach a tool to a line attached to your wrist or any other part of your body.

- When you are working on a derrick platform, do not guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or a traveling block.

- Loose tools and similar items should not be left on the derrick platform or on structural members of the derrick.

- A derrick platform over 4 ft. (1.2 m) above ground surface should have toe boards and safety railing that are in good condition.

- Workers on the ground or the drilling floor should avoid being under rig workers on elevated platforms, whenever possible.

Be careful when lifting heavy objects:

- Before lifting any object without using a hoist, make sure that the load is within your personal lifting capacity. If it is too heavy, ask for assistance.

- Before lifting a relatively heavy object, approach the object by bending at the knees, keeping your back vertical and unarched while obtaining a firm footing. Grasp the object firmly with both hands and stand slowly and squarely while keeping your back vertical and unarched. In other words, perform the lifting with the muscles in your legs, not with the muscles in your lower back.

- If a heavy object must be moved some distance without the aid of machinery, keep your back straight and unarched. Change directions by moving your feet, not by twisting your body.

- Move heavy objects with the aid of hand carts whenever possible.

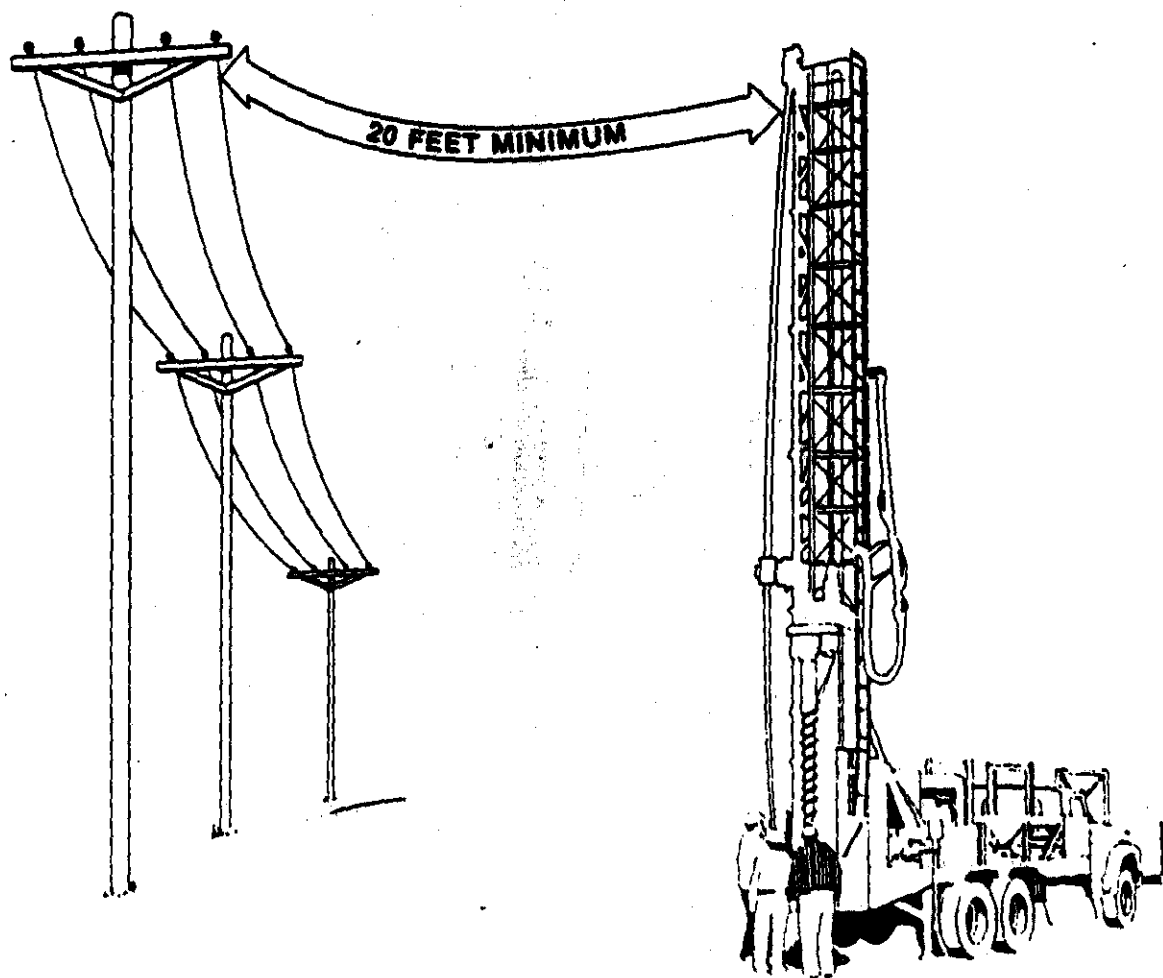
Drilling operations should be terminated during an electrical storm and the complete crew should move away from the drill rig.

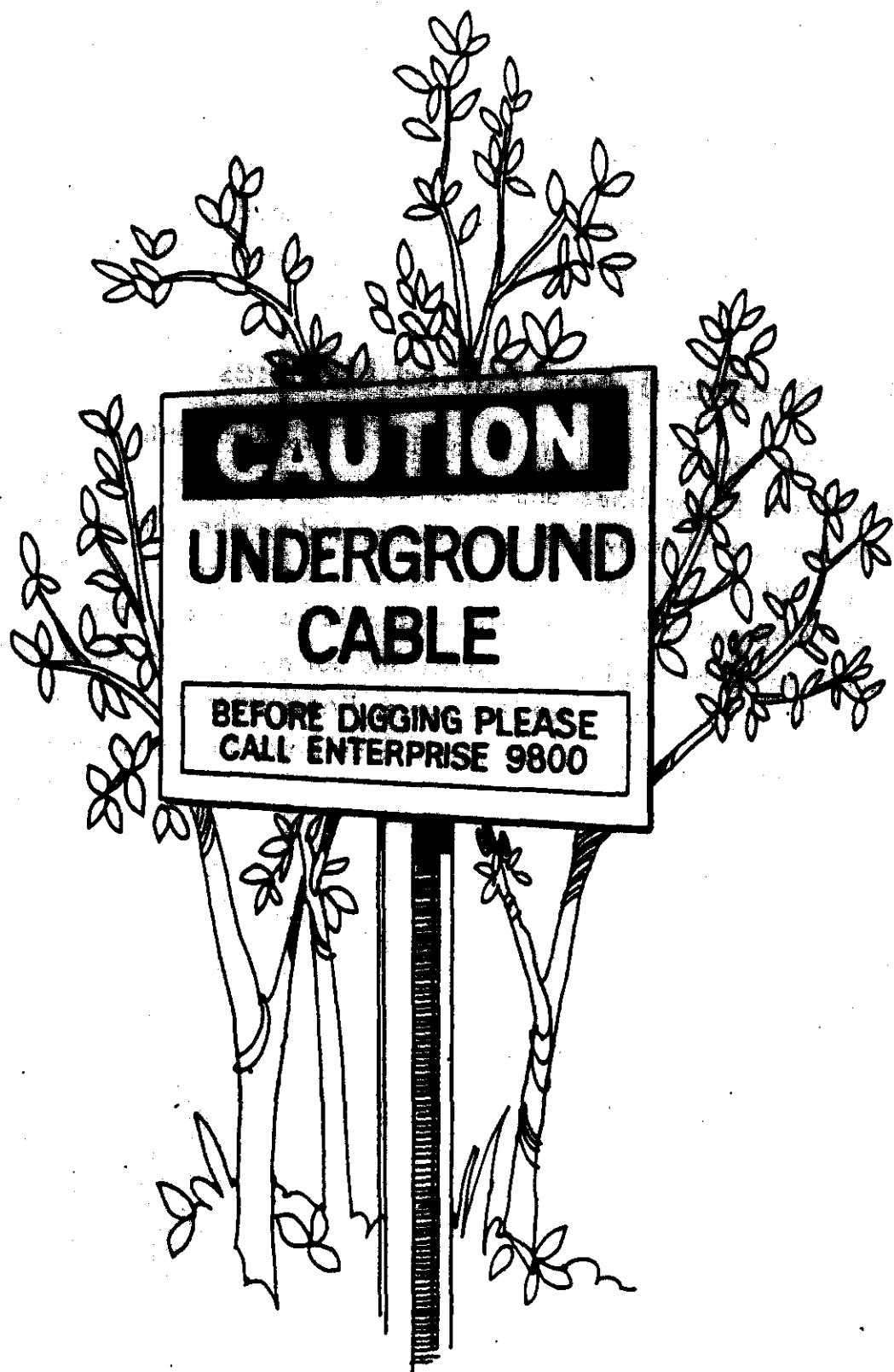
11. Overhead And Buried Utilities

The use of a drill rig on a site or project within the vicinity of electrical power lines and other utilities requires that special precautions be taken by both supervisors and members of the exploration crew. Electricity can shock, it can burn and it can cause death.

- Overhead and buried utilities should be located, noted and emphasized on all boring location plans and boring assignment sheets.

- When overhead electrical power lines exist at or near a drilling site or project, consider all wires to be alive and dangerous.





- Watch for sagging power lines before entering a site. Do not lift power lines to gain entrance. Call the utility and ask them to lift or raise the lines or deenergize (turn off) the power.
- Before raising the drill rig mast (derrick) on a site in the vicinity of power lines, walk completely around the drill rig. Determine what the minimum distance from any point on the drill rig to the nearest

power line will be when the mast is raised and/or being raised. Do not raise the mast or operate the drill rig if this distance is less than 20 ft. (6 m), or if known, the minimum clearance stipulated by federal, state and local regulations.

- Keep in mind that both hoist lines and overhead power lines can be moved toward each other by the wind.

- In order to avoid contact with power lines, only move the drill rig with the mast (derrick) down.

- If there are any questions whatever concerning the safety of drilling on sites in the vicinity of overhead power lines, call the power company. The power company will provide expert advice at the drilling site as a public service and at no cost.

Underground electricity is as dangerous as overhead electricity. Be aware and always suspect the existence of underground utilities such as electrical power, gas, petroleum, telephone, sewer and water. Ask for assistance:

- If a sign warning of underground utilities is located on a site boundary, do not assume that underground utilities are located on or near the boundary or property line under the sign: call the utility and check it out. The underground utilities may be a considerable distance away from the warning sign.

- Always contact the owners of utility lines or the nearest underground utility location service before drilling. Determine jointly with utility personnel the precise location of underground utility lines, mark and flag the locations and determine jointly with utility personnel what specific precautions must be taken to assure safety.

12. Safe Use Of Electricity

Drilling projects sometimes require around-the-clock operations and, therefore, require temporary electrical lighting. In general, all wiring and fixtures used to provide electricity for drilling operations should be installed by qualified personnel in accordance with the National Electrical Code (NFPA70-1984) with consideration of the American Petroleum Institute's recommended practices for electrical installations for production facilities (API-RP-500B). Lights should be installed and positioned to assure that the work area and operating

13. React To Contact With Electricity

If a drill rig makes contact with electrical wires, it may or may not be insulated from the ground by the tires of the carrier. Under either circumstance the human body, if it simultaneously comes in contact with the drill rig and the ground, will provide a conductor of the electricity to the ground. Death or serious injury can be the result. If a drill rig or a drill rig carrier makes contact with overhead or underground electrical lines:

- Under most circumstances, the operator and other personnel on the seat of the vehicle should remain seated and not leave the vehicle. Do not move or touch any part, particularly a metallic part, of the vehicle or the drill rig.
- If it is determined that the drill rig should be vacated, then all personnel should jump clear and as far as possible from the drill. Do not step off – jump off, and do not hang on to the vehicle or any part of the drill when jumping clear.
- If you are on the ground, stay away from the vehicle and the drill rig, do not let others get near the vehicle and the drill rig and seek assistance from local emergency personnel such as the police or a fire department.
- When an individual is injured and in contact with the drill rig or with power lines, attempt rescue with extreme caution. If a rescue is attempted, use a long, dry, unpainted piece of wood or a long, dry, clean rope. Keep as far away from the victim as possible and do not touch the victim until the victim is completely clear of the drill rig or electrical lines.
- When the victim is completely clear of the electrical source and is unconscious and a heart beat (pulse) cannot be detected, begin cardiopulmonary resuscitation (CPR) immediately.

14. Safe Use Of Wire Line Hoists, Wire Rope And Hoisting Hardware

The use of wire line hoists, wire rope and hoisting hardware should be as stipulated by the American Iron and Steel Institute Wire Rope Users Manual.

drilling environment. Makeshift wiring and equipment should not be permitted.

- All lights positioned directly above working areas should be enclosed in cages or similar enclosures to prevent loose or detached lamps or vaportight enclosures from falling on workers.

- Lights should be installed to produce the least possible glare or "blind spots" on tools, ladders, walkways, platforms and the complete working area.

- Electrical cables should be guarded and located to prevent damage by drilling operations or by the movement of personnel, tools or supplies.

- All plug receptacles should be the three-prong, U-blade, grounded type and have adequate current carrying capacity for the electrical tools that may be used.

- All electric tools should have three-prong, U-blade, ground wire plugs and cords.

- Do not use electrical tools with lock-on devices.

- All electrical welders, generators, control panels and similar devices should be adequately grounded.

- Control panels, fuse boxes, transformers and similar equipment should have a secure, protective enclosure.

- Avoid-attaching electrical lighting cables to the derrick or other components of the drill rig. If this must be done, use only approved fasteners. Do not "string" wire through the derrick.

- Poles used to hold wiring and lights should not be used for any other purpose.

- Power should be turned off before changing fuses or light bulbs.

- When a drilling area is illuminated with electrical lighting, all workers should wear safety head gear that protects the worker's head, not only against falling or flying objects, but also against limited electrical shock and burn according to ANSI Z89.1 and Z89.2.

- Electrical equipment should only be operated by trained, designated personnel.

- If you are not qualified to work on electrical devices or on electric lines, do not go near them.

sheaves according to the manufacturer's recommendations.

- When stuck tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the stuck tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull to the hoist line or the feed mechanism of the drill.

- When attempting to pull out a mired down vehicle or drill rig carrier, only use a winch on the front or rear of the vehicle and stay as far as possible away from the wire rope. Do not attempt to use tool hoists to pull out a mired down vehicle or drill rig carrier.

- Minimize shock loading of a wire rope – apply loads smoothly and steadily.

- Avoid sudden loading in cold weather.

- Never use frozen ropes.

- Protect wire rope from sharp corners or edges.

- Replace faulty guides and rollers.

- Replace worn sheaves or worn sheave bearings.

- Replace damaged safety latches on safety hooks before using.

- Know the safe working load of the equipment and tackle being used. Never exceed this limit.

- Clutches and brakes of hoists should be periodically inspected and tested.

- Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles and other lifting aids.

- Always wear gloves when handling wire ropes.

- Do not guide wire rope on hoist drums with your hands.

- Following the installation of a new wire rope, first lift a light load to allow the wire rope to adjust.

- Never carry out any hoisting operations when the weather conditions are such that hazards to personnel, the public or property are created.

- Never leave a load suspended in the air when the hoist is unattended.

- Keep your hands away from hoists, wire rope, hoisting hooks, sheaves and pinch points as slack is being taken up and when the load is being hoisted.

- Never hoist the load over the head, body or feet of any personnel.

- All wire ropes and fittings should be visually inspected during use and thoroughly inspected at least once a week for: abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper reeving, jamming, crushing, bird caging, kinking, core protrusion and damage to lifting hardware. Wire ropes should be replaced when inspection indicates excessive damage according to the Wire Rope Users Manual. All wire ropes which have not been used for a period of a month or more should be thoroughly inspected before being returned to service.

- End fittings and connections consist of spliced eyes and various manufactured devices. All manufactured end fittings and connections should be installed according to the manufacturer's instructions and loaded according to the manufacturer's specifications.

- If a ball-bearing type hoisting swivel is used to hoist drill rods, swivel bearings should be inspected and lubricated daily to assure that the swivel freely rotates under load.

- If a rod slipping device is used to hoist drill rods, do not drill through or rotate drill rods through the slipping device, do not hoist more than 1 ft. (0.3 m) of the drill rod column above the top of the mast (derrick), do not hoist a rod column with loose tool joints and do not make up, tighten or loosen tool joints while the rod column is being supported by a rod slipping device. If drill rods should slip back into the borehole, do not attempt to brake the fall of the rods with your hands or by tensioning the slipping device.

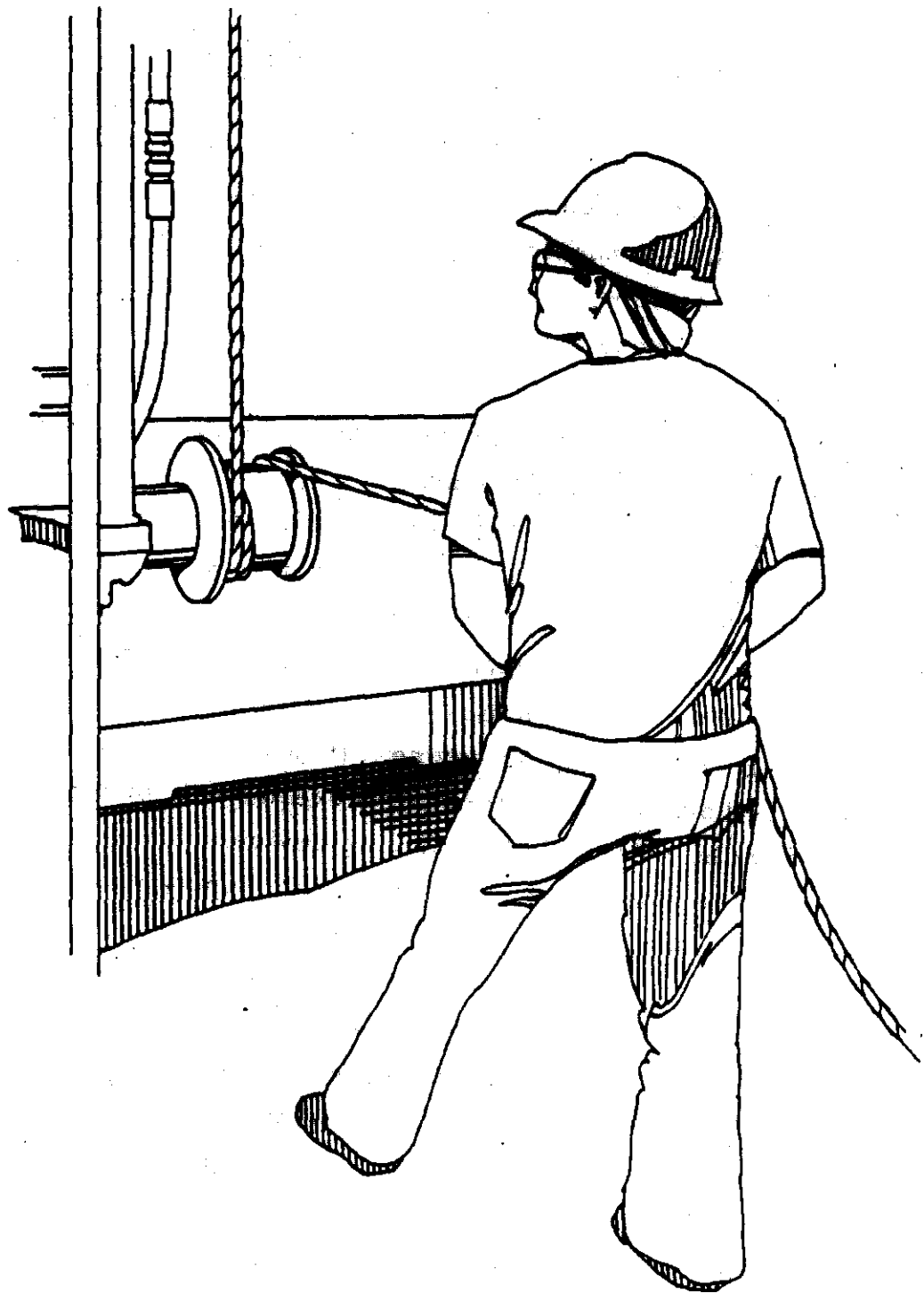
- Most sheaves on exploration drill rigs are stationary with a single part line. The number of parts of line should not ever be increased without first consulting with the manufacturer of the drill rig.

- Wire ropes must be properly matched with each sheave – if the rope is too large, the sheave will pinch the wire rope – if the rope is too small, it will groove the sheave. Once the sheave is grooved, it will severely pinch and damage larger sized wire ropes.

The following procedures and precautions must be understood and implemented for safe use of wire ropes and rigging hardware.

- Use tool handling hoists only for vertical lifting of tools (except when angle hole drilling). Do not use tool handling hoists to pull on objects away from the drill rig; however, drills may be moved using the main hoist if the wire rope is spooled through proper

- Never operate a cathead (or perform any other task around a drill rig) with loose unbuttoned or otherwise unfastened clothing or when wearing gloves with large cuffs or loose straps or lacings.



- Do not use a rope that is any longer than necessary. A rope that is too long can form a ground loop or otherwise become entangled with the operator's leas.

- Do not use more rope wraps than are required to hoist a load.
- Do not leave a cathead unattended with the rope wrapped on the drum.
- Position all other hoist lines to prevent contact with the operating cathead rope.
- When using the cathead and rope for driving or back-driving, make sure that all threaded connections are tight and stay as far away as possible from the hammer impact point.
- The cathead operator must be able to operate the cathead standing on a level surface with good, firm footing conditions without distraction or disturbance.

16. Safe Use Of Augers

The following general procedures should be used when starting a boring with continuous flight or hollow-stem augers:

- Prepare to start an auger boring with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear and the engine running at low RPM.
- Apply an adequate amount of down pressure prior to rotation to seat the auger head below the ground surface.
- Look at the auger head while slowly engaging the clutch or rotation control and starting rotation. Stay clear of the auger.
- Slowly rotate the auger and auger head while continuing to apply down pressure. Keep one hand on the clutch or the rotation control at all times until the auger has penetrated about one foot or more below ground surface.
- If the auger head slides out of alignment, disengage the clutch or hydraulic rotation control and repeat the hole starting process.
- An auger guide can facilitate the starting of a straight hole through hard ground or a pavement.

The operator and tool handler should establish a system of responsibility for the series of various activities required for auger drilling, such as connecting and disconnecting auger sections, and inserting and removing the auger fork. The operator must assure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation.

- Only use the manufacturer's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger with your hands, a wrench or any other tools during rotation.
- Whenever possible, use tool hoists to handle auger sections.
- Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.
- When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason whatever.
- Use a long-handled shovel to move auger cuttings away from the auger. Never use your hands or feet to move cuttings away from the auger.
- Do not attempt to remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.

17. Safety During Rotary And Core Drilling

Rotary drilling tools should be safety checked prior to drilling:

- Water swivels and hoisting plugs should be lubricated and checked for "frozen" bearings before use.
- Drill rod chuck jaws should be checked periodically and replaced when necessary.
- The capacities of hoists and sheaves should be checked against the anticipated weight to the drill rod string plus other expected hoisting loads.

Special precautions that should be taken for safe rotary or core drilling involve chucking, joint break, hoisting and lowering of drill rods:

- Only the operator of the drill rig should brake or set a manual chuck so that rotation of the chuck will not occur prior to removing the wrench from the chuck.
- Drill rods should not be braked during lowering into the hole with drill rod chuck jaws.

- Drill rods should not be held or lowered into the hole with pipe wrenches.

- If a string of drill rods are accidentally or inadvertently released into the hole, do not attempt to grab the falling rods with your hands or a wrench.

- In the event of a plugged bit or other circulation blockage, the high pressure in the piping and hose between the pump and the obstruction should be relieved or bled down before breaking the first tool joint.

- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use your hands to clean drilling fluids from drill rods.

- If work must progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough surfaced, fitted cover panels of adequate strength to hold drill rig personnel.

- Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

18. Safety During Travel

The individual who transports a drill rig on and off a drilling site should:

- Be properly licensed and should only operate the vehicle according to federal, state and local regulations.

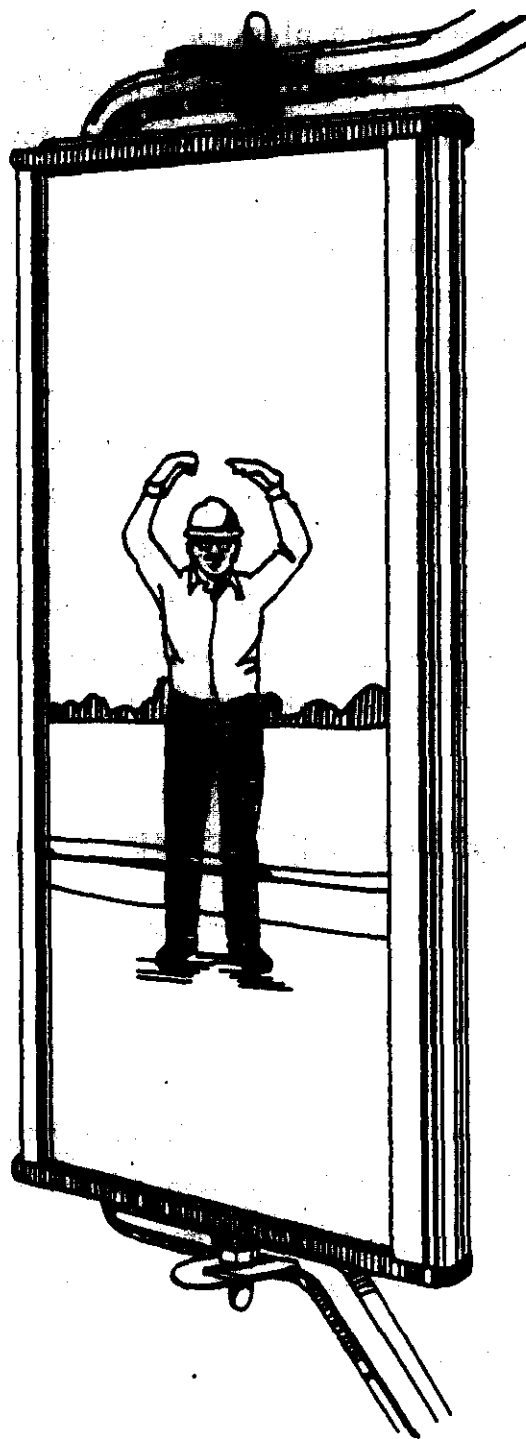
- Know the traveling height (overhead clearance), width, length and weight of the drill rig with carrier and know highway and bridge load, width and overhead limits, making sure these limits are not exceeded with an adequate margin.

- Never move a drill rig unless the vehicle brakes are in sound working order.

- Allow for mast overhang when cornering or approaching other vehicles or structures.

- Be aware that the canopies of service stations and motels are often too low for a drill rig mast to clear with the mast in the travel position.

- Watch for low hanging electrical lines, particularly at the entrances to drilling sites or restaurants, motels or other commercial sites.



- Never travel on a street, road or highway with the mast (derrick) of the drill rig in the raised or partially raised position.
- Remove all ignition keys when a drill rig is left unattended.

19. Loading And Unloading

When loading or unloading a drill rig on a trailer or a truck:

- Use ramps of adequate design that are solid and substantial enough to bear the weight of the drill rig with carrier - including tooling.
- Load and unload on level ground.
- Use the assistance of someone on the ground as a guide.
- Check the brakes on the drill rig carrier before approaching loading ramps.
- Distribute the weight of the drill rig, carrier and tools on the trailer so that the center of weight is approximately on the center-line of the trailer and so that some of the trailer load is transferred to the hitch of the pulling vehicle. Refer to the trailer manufacturer's weight distribution recommendations.
- The drill rig and tools should be secured to the hauling vehicle with ties, chains and/or load binders of adequate capacity.

20. Off-Road Movement

The following safety suggestions relate to off-road movement:

- Before moving a drill rig, first walk the route of travel, inspecting for depressions, stumps, gulleys, ruts and similar obstacles.
- Always check the brakes of a drill rig carrier before traveling, particularly on rough, uneven or hilly ground.
- Check the complete drive train of a carrier at least weekly for loose or damaged bolts, nuts, studs, shafts and mountings.
- Discharge all passengers before moving a drill rig on rough or hilly terrain.
- Engage the front axle (for 4 x 4, 6 x 6, etc. vehicles or carriers) when traveling off highway on hilly terrain.
- Use caution when traveling side-hill. Conservatively evaluate side-hill capability of drill rigs, because the arbitrary addition of drilling tools may raise the center of mass. When possible, travel directly uphill or downhill. Increase tire pressures before traveling in hilly terrain (do not exceed rated tire pressure).
- Attempt to cross obstacles such as small logs and small erosion

channels or ditches squarely, not at an angle.

- Use the assistance of someone on the ground as a guide when lateral or overhead clearance is close.
- After the drill has been moved to a new drilling site, set all brakes and/or locks. When grades are steep, block the wheels.
- Never travel off-road with the mast (derrick) of the drill rig in the raised or partially raised position.

21. Tires, Batteries And Fuel

Tires on the drill rig must be checked daily for safety and during extended travel for loss of air and they must be maintained and/or repaired in a safe manner. If tires are deflated to reduce ground pressure for movement on soft ground, the tires should be reinflated to normal pressures before movement on firm or hilly ground or on streets, roads and highways. Under inflated tires are not as stable on firm ground as properly inflated tires. Air pressures should be maintained for travel on streets, roads and highways according to the manufacturer's recommendations. During air pressure checks, inspect for:

- Missing or loose wheel lugs.
- Objects wedged between duals or embedded in the tire casing.
- Damaged or poorly fitting rims or rim flanges.
- Abnormal or uneven wear and cuts, breaks or tears in the casing.

The repair of truck and off-highway tires should only be made with required special tools and following the recommendations of a tire manufacturer's repair manual.

Batteries contain strong acid. Use extreme caution when servicing batteries.

- Batteries should only be serviced in a ventilated area while wearing safety glasses.
- When a battery is removed from a vehicle or service unit, disconnect the battery ground clamp first.
- When installing a battery, connect the battery ground clamp last.
- When charging a battery with a battery charger, turn off the power source to the battery before either connecting or disconnecting charger leads to the battery posts. Cell caps should be loosened

prior to charging to permit the escape of gas.

- Spilled battery acid can burn your skin and damage your eyes. Spilled battery acid should be immediately flushed off of your skin with lots of water. Should battery acid get into someone's eyes, flush immediately with large amounts of water and see a medical physician at once.

- To avoid battery explosions, keep the cells filled with electrolyte, use a flashlight (not an open flame) to check electrolyte levels and avoid creating sparks around the battery by shorting across a battery terminal. Keep lighted smoking materials and flames away from batteries.

Special precautions must be taken for handling fuel and refueling the drill rig or carrier.

- Only use the type and quality of fuel recommended by the engine manufacturer.

- Refuel in a well-ventilated area.

- Do not fill fuel tanks while the engine is running. Turn off all electrical switches.

- Do not spill fuel on hot surfaces. Clean any spillage before starting an engine.

- Wipe up spilled fuel with cotton rags or cloths – do not use wool or metallic cloth.

- Keep open lights, lighted smoking materials and flames or sparking equipment well away from the fueling area.

- Turn off heaters in carrier cabs when refueling the carrier or the drill rig.

- Do not fill portable fuel containers completely full to allow expansion of the fuel during temperature changes.

- Keep the fuel nozzle in contact with the tank being filled to prevent static sparks from igniting the fuel.

- Do not transport portable fuel containers in the vehicle or carrier cab with personnel.

- Fuel containers and hoses should remain in contact with a metal surface during travel to prevent the buildup of static charge.